



Navy Littoral Combat Ship (LCS) Program: Background, Issues, and Options for Congress

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Summary

The Littoral Combat Ship (LCS) is a relatively inexpensive Navy surface combatant equipped with modular “plug-and-fight” mission packages. The Navy wants to field a force of 55 LCSs.

The first two LCSs (LCS-1 and LCS-2) were procured in FY2005 and FY2006 and were commissioned into service on November 8, 2008, and January 16, 2010. Another two (LCS-3 and LCS-4) were procured in FY2009 and are under construction. Two more (LCS-5 and LCS-6) were procured in FY2010 and are under contract. The Navy’s proposed FY2011 budget requested funding to procure an additional two (LCS-7 and LCS-8). Although the Navy’s FY2011 funding has not yet been fully determined, the Navy announced on March 17 that it had brought these two ships under contract. The Navy’s proposed FY2012 budget requests funding to procure four more (LCSs 9 through 12). Navy plans call for procuring an additional 15 LCSs in FY2013-FY2016 in annual quantities of 4-4-4-3.

There are two very different LCS designs—one developed and produced by an industry team led by Lockheed, and another developed and produced by an industry team led by General Dynamics. The Lockheed design is built at the Marinette Marine shipyard at Marinette, WI; the General Dynamics design is built at the Austal USA shipyard at Mobile, AL.

On November 3, 2010, the Navy notified congressional offices that it was prepared to implement a dual-award acquisition strategy under which the Navy would award each LCS builder a 10-ship contract for the six-year period FY2010-FY2015. The Navy stated that, compared to an earlier down select strategy that the Navy had announced in September 2009, the dual-award strategy would reduce LCS procurement costs by hundreds of millions of dollars. The Navy needed additional legislative authority from Congress to implement the dual-award strategy. Congress granted the authority in Section 150 of H.R. 3082/P.L. 111-322 of December 22, 2010, an act that, among other things, funded federal government operations through March 4, 2011. On December 29, 2010, the Navy implemented the dual-award strategy, awarding a 10-ship, fixed-price incentive (FPI) block-buy contract to Lockheed, and another 10-ship, FPI block-buy contract to Austal USA. LCSs 5 through 8 are the first four LCSs executed under the two block-buy contracts.

Current issues for Congress concerning the LCS program include the Navy’s lack of economic order quantity (EOQ) authority for executing the two block-buy contracts, changes or potential changes to the composition of LCS mission modules announced by the Navy in January 2011, the combat survivability of the LCS, and hull cracking on LCS-1.

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Introduction

This report provides background information and potential issues for Congress on the Littoral Combat Ship (LCS), a relatively inexpensive Navy surface combatant equipped with modular “plug-and-fight” mission packages. The Navy’s proposed FY2012 budget requests funding for the procurement of four LCSs.

Current issues for Congress concerning the LCS program include changes or potential changes to the composition of LCS mission modules announced by the Navy in January 2011, the combat survivability of the LCS, and hull cracking on LCS-1. Congress’s decisions on the LCS program could affect Navy capabilities and funding requirements, and the shipbuilding industrial base.

Background

The Program in General

The LCS in Brief

The LCS program was announced on November 1, 2001.¹ The LCS is a relatively inexpensive Navy surface combatant that is to be equipped with modular “plug-and-fight” mission packages, including unmanned vehicles (UVs). Rather than being a multimission ship like the Navy’s larger surface combatants, the LCS is to be a focused-mission ship, meaning a ship equipped to perform one primary mission at any given time. The ship’s mission orientation can be changed by changing out its mission packages. The basic version of the LCS, without any mission packages, is referred to as the LCS sea frame.

The LCS’s primary intended missions are antisubmarine warfare (ASW), mine countermeasures (MCM), and surface warfare (SUW) against small boats (including so-called “swarm boats”), particularly in littoral (i.e., near-shore) waters. The LCS program includes the development and procurement of ASW, MCM, and SUW mission packages for LCS sea frames. The LCS’s permanently built-in gun gives it some ability to perform the SUW mission even without an SUW module.

Additional missions for the LCS include peacetime engagement and partnership-building operations, intelligence, surveillance, and reconnaissance (ISR) operations, maritime intercept operations, operations to support special operations forces, and homeland defense operations. An LCS might perform these missions at any time, regardless of its installed mission module,

¹ On November 1, 2001, the Navy announced that it was launching a Future Surface Combatant Program aimed at acquiring a family of next-generation surface combatants. This new family of surface combatants, the Navy stated, would include three new classes of ships: a destroyer called the DD(X)—later redesignated the DDG-1000—for the precision long-range strike and naval gunfire mission; a cruiser called the CG(X) for the air defense and ballistic missile mission, and a smaller combatant called the Littoral Combat Ship (LCS) to counter submarines, small surface attack craft, and mines in heavily contested littoral (near-shore) areas. For more on the DDG-1000 program, see CRS Report RL32109, *Navy DDG-51 and DDG-1000 Destroyer Programs: Background and Issues for Congress*, by Ronald O’Rourke. For more on the CG(X) program, see CRS Report RL34179, *Navy CG(X) Cruiser Program: Background for Congress*, by Ronald O’Rourke.

although an installed mission module might enhance an LCS's ability to perform some of these missions.

The LCS displaces about 3,000 tons, making it about the size of a corvette (i.e., a light frigate) or a Coast Guard cutter. It has a maximum speed of more than 40 knots, compared to something more than 30 knots for the Navy cruisers and destroyers. The LCS has a shallower draft than Navy cruisers and destroyers, permitting it to operate in certain coastal waters and visit certain ports that are not accessible to Navy cruisers and destroyers. The LCS employs automation to achieve a reduced "core" crew of 40 sailors. Up to 35 or so additional sailors are to operate the ship's embarked aircraft and mission packages, making for a total crew of about 75, compared to more than 200 for the Navy's frigates and about 300 (or more) for the Navy's current cruisers and destroyers.

Planned Procurement Quantities

The Navy plans to field a force of 55 LCS sea frames and 64 LCS mission packages (16 ASW, 24 MCM, and 24 SUW). The Navy's planned force of 55 LCSs would account for about one-sixth of the Navy's planned fleet of more than 300 ships of all types.²

Navy plans call for procuring 19 LCSs in the five-year period FY2012-FY2016, in annual quantities of 4-4-4-4-3. These 19 ships account for more than one-third of the 55 battle force ships in the Navy's FY2012-FY2016 shipbuilding plan. The Navy's FY2011-FY2040 30-year shipbuilding plan, submitted to Congress in February 2010 in conjunction with the FY2011 budget, shows three LCSs per year for FY2016-FY2019, two per year for FY2020-FY2024, a 1-2-1-2 pattern for FY2025-FY2033, and two per year for FY2034-FY2040. LCSs scheduled for procurement in the final years of the 30-year plan would be replacements for LCSs that will have reached the end of their 25-year expected service lives by that time.

Two LCS Designs

On May 27, 2004, the Navy awarded contracts to two industry teams—one led by Lockheed Martin, the other by General Dynamics (GD)—to design two versions of the LCS, with options for each team to build up to two LCSs each. The LCS designs developed by the two teams are quite different—the Lockheed team's design is based on a steel semi-planing monohull, while GD team's design is based on an aluminum trimaran hull (see **Figure 1**). The two ships also use different built-in combat systems (i.e., different collections of built-in sensors, computers, software, and tactical displays) that were designed by each industry team. The Navy states that both LCS designs meet the Key Performance Parameters (KPPs) for the LCS program.

² For more on the Navy's planned fleet, see CRS Report RL32665, *Navy Force Structure and Shipbuilding Plans: Background and Issues for Congress*, by Ronald O'Rourke.

Figure 1. Lockheed LCS Design (Top) and General Dynamics LCS Design (Bottom)



Source: Source: U.S. Navy file photo accessed by CRS at http://www.navy.mil/list_all.asp?id=57917 on January 6, 2010.

Two LCS Shipyards

The Lockheed LCS design is built at the Marinette Marine shipyard at Marinette, WI.³ The GD LCS design is built at the Austal USA shipyard at Mobile, AL.⁴ Odd-numbered LCSs (i.e., LCS-1, LCS-3, LCS-5, and so on) use the Lockheed design; even numbered LCSs (i.e., LCS-2, LCS-4, LCS-6, and so on) use the GD design.

Table 1 shows the construction status of the first eight LCSs.⁵ The Navy's proposed FY2011 budget requested funding to procure two LCSs (LCS-7 and LCS-8). Although the Navy's FY2011 funding as of mid-March 2011 had not yet been fully determined, the Navy announced on March 17 that it had brought the two FY2011 LCSs under contract.⁶ LCSs 5 through 8 are the first four LCSs executed under the two LCS block-buy contracts that are described later in this report (see "2010 Dual-Award Acquisition Strategy (Implemented)").

³ Marinette Marine is a division of the Fincantieri Marine Group, an Italian shipbuilding firm. In 2009, Fincantieri purchased Manitowoc Marine Group, the owner of Marinette Marine and two other shipyards. Lockheed is a minority investor in Marinette Marine.

⁴ Austal USA was created in 1999 as a joint venture between Austal Limited of Henderson, Western Australia, and Bender Shipbuilding & Repair Company of Mobile, AL, with Austal Limited as the majority owner.

⁵ **Table 1** excludes five LCSs that were funded in FY2006-FY2008 but later canceled by the Navy; these five canceled LCSs are shown in **Table D-1** in **Appendix D**.

⁶ "Fiscal year 2011 Littoral Combat Ship Contract Awards Announced," Navy News Service, March 17, 2011, accessed online at http://www.navy.mil/search/display.asp?story_id=59150. The Navy states that it "is able to make these awards [i.e., bring LCS-7 and LCS-8 under contract] under the Continuing Resolution because the construction contracts for the [two] FY 2011 ships and associated Government Furnished Equipment (GFE) and programmatics were appropriated within the Continuing Resolution Authority constraints which are based on FY 2010 funding controls." (Source: Navy Office of Legislative Affairs e-mail to CRS, March 18, 2011.) In other words, the Navy determined that it was able to bring LCS-7 and LCS-8 under contract, even though the Navy's final FY2011 funding level had not yet been determined as of mid-March 2011, because the two ships could be funded within an amount of money equal to the FY2010 funding level in the Shipbuilding and Conversion, Navy (SCN) appropriation account for the LCS program, and the Navy judged that the final FY2011 SCN funding level for the LCS program would likely be at least equal to the FY2010 SCN funding level. The Navy's requested FY2011 SCN funding level for the LCS program was greater than the FY2010 funding level for the program, but the higher amount of funding requested for FY2011 did not reflect the reduction in LCS procurement costs achieved through the Navy's use of block-buy contracting for the LCS program.

Table I. Construction Status of LCSs

FY funded	Navy hull designation	Shipyard	Status
2005	LCS-1	Marinette Marine	Commissioned into service November 8, 2008.
2006	LCS-2	Austal USA	Commissioned into service January 16, 2010.
2009	LCS-3	Marinette Marine	Under construction. Delivery scheduled for February 2012.
	LCS-4	Austal USA	Under construction. Delivery scheduled for June 2012.
2010	LCS-5	Marinette Marine	Under contract. Delivery scheduled for September 2014.
	LCS-6	Austal USA	Under contract. Delivery scheduled for July 2014.
2011	LCS-7	Marinette Marine	Under contract. Delivery scheduled for October 2013 or April 2014.
	LCS-8	Austal USA	Under contract. Delivery scheduled for December 2013 or June 2014.

Source: Prepared by CRS based on FY2012 Navy budget submission.

Notes: (1) Table excludes five LCSs funded in FY2006-FY2008 but later canceled by the Navy; these five canceled LCSs are shown in **Table D-1** in **Appendix D**.

(2) CRS on March 18, 2011, asked the Navy to confirm or correct the scheduled delivery dates shown for LCSs 5 through 8, because the dates shown for LCS-5 and LCS-6, are later than those shown for LCS-7 and LCS-8, respectively. In addition, Navy budget documents (pages 11-1 and 11-4 of the FY2012 justification book for the SCN account) also provide two different delivery dates for LCS-7 and LCS-8.

Unit Procurement Cost Cap

LCS sea frames procured in FY2010 and subsequent years are subject to a unit procurement cost cap. The legislative history of the cost cap is as follows:

- The cost cap was originally established by **Section 124 of the FY2006 defense authorization act** (H.R. 1815/P.L. 109-163 of January 6, 2006). Under this provision, the fifth and sixth ships in the class were to cost no more than \$220 million each, plus adjustments for inflation and other factors.
- The cost cap was amended by **Section 125 of the FY2008 defense authorization act** (H.R. 4986/P.L. 110-181 of January 28, 2008). This provision amended the cost cap to \$460 million per ship, with no adjustments for inflation, and applied the cap to all LCSs procured in FY2008 and subsequent years.
- The cost cap was amended again by **Section 122 of the FY2009 defense authorization act** (S. 3001/P.L. 110-417 of October 14, 2008). This provision deferred the implementation of the cost cap by two years, applying it to all LCSs procured in FY2010 and subsequent years.
- The cost cap was amended again by **Section 121(c) and (d) of the FY2010 defense authorization act** (H.R. 2647/P.L. 111-84 of October 28, 2009). The provision adjusted the cost cap to \$480 million per ship, excluded certain costs from being counted against the \$480 million cap, included provisions for adjusting the \$480 million figure over time to take inflation and other events into account, and permitted the Secretary of the Navy to waive the cost cap under

certain conditions.⁷ The Navy states that after taking inflation into account, the \$480 million figure equates, as of December 2010, to \$538 million.

Estimated Acquisition Cost

The Department of Defense's (DOD's) December 31, 2010, Selected Acquisition Report (SAR) for the LCS program, which was released in mid-April 2011, estimates the total acquisition cost for 55 LCS sea frames at \$37,438.8 million (i.e., about \$37.4 billion) in then-year dollars. This figure includes \$3,481.7 million in research and development costs (including funds for the construction of LCS-1 and LCS-2), \$33,720.5 million in procurement costs for LCSs 3 through 55, and \$236.6 million in military construction (MilCon) costs. The SAR reports that, in constant FY2010 dollars, these figures become \$31,996.8 million, including \$3,426.8 million in research and development costs, \$28,364.0 million in procurement costs, and \$206.0 million in MilCon costs, respectively.⁸

The December 31, 2010, SAR does not contain estimated acquisition costs for the planned total of 64 LCS mission packages. The SAR states:

On February 18, 2011, USD(AT&L)⁹ conducted a Milestone B (MS B) Defense Acquisition Board (DAB) for the seaframe portion of the LCS program. The decision of the DAB was to separate the program into two separate and distinct programs with separate reporting requirements. The Seaframe portion of the program is reported in this SAR as approved at MS B. The Mission Module portion of the program will begin reporting when it receives its Milestone B decision.¹⁰

Estimated Operation and Support (O&S) Cost

DOD's December 31, 2010, SAR for the sea frame portion of the LCS program estimates the total life-cycle operation and support (O&S) cost for 55 sea frames, each operated for 25 years, at \$87,089.3 million (i.e., about \$87.1 billion) in then-year dollars, or \$50,479.0 million in constant FY2010 dollars. The SAR estimates the annual O&S cost of a single LCS sea frame at \$36.6 million in constant FY2010 dollars.¹¹ (Dividing the figure of \$50,479.0 million by 55 ships and 25 years per ship produces a figure of \$36.7 million per ship per year.) The SAR states that these

⁷ Section 121(d)(1) states that the Secretary of the Navy may waive the cost cap if:

(A) the Secretary provides supporting data and certifies in writing to the congressional defense committees that—

(i) the total amount obligated or expended for procurement of the vessel-

(I) is in the best interest of the United States; and

(II) is affordable, within the context of the annual naval vessel construction plan required by section 231 of title 10, United States Code; and

(ii) the total amount obligated or expended for procurement of at least one other vessel authorized by subsection (a) has been or is expected to be less than \$480,000,000; and

(B) a period of not less than 30 days has expired following the date on which such certification and data are submitted to the congressional defense committees.

⁸ Department of Defense, *Selected Acquisition Report (SAR), LCS*, as of December 31, 2010, p. 14.

⁹ The Under Secretary of Defense (Acquisition, Technology, and Logistics) – DOD's acquisition executive.

¹⁰ Department of Defense, *Selected Acquisition Report (SAR), LCS*, as of December 31, 2010, p. 4.

¹¹ Department of Defense, *Selected Acquisition Report (SAR), LCS*, as of December 31, 2010, p. 37.

estimates are based on certain assumptions, including an average Defense Energy Support Center (DESC) price of fuel of \$117.60 per barrel in constant FY2010 dollars. The SAR states that the “source of [the] estimate is the Navy Service Cost Position and OSD Independent Cost Estimate developed and approved in support of LCS Seaframe Milestone B decision February, 2011.” The estimated O&S costs in the SAR appear to be for the 55 LCS sea frames only; they do not appear to include O&S costs (including associated personnel costs) for LCS mission modules.

The Congressional Budget Office (CBO) estimated O&S costs for LCS sea frames in an April 28, 2010, letter.¹² A February 2010 Government Accountability Office (GAO) report commented on a 2009 Navy estimate of LCS O&S costs.¹³

Manning and Deployment Concept

The Navy plans to maintain three LCS crews for each two LCSs, and to keep one of those two LCSs continuously underway—a plan Navy officials sometimes refer to as “3-2-1.” Under the 3-2-1 plan, LCSs are to be deployed for 16 months at a time, and crews are to rotate on and off deployed ships at four-month intervals.¹⁴ The 3-2-1 plan will permit the Navy to maintain a greater percentage of the LCS force in deployed status at any given time than would be possible under the traditional approach of maintaining one crew for each LCS and deploying LCSs for six or seven months at a time.

¹² Letter dated April 28, 2010, from Douglas W. Elmendorf, Director, CBO, to the Honorable Jeff Sessions, 8 pp. The full text of the letter is available online at <http://www.cbo.gov/ftpdocs/114xx/doc11431/04-28-SessionsLetter.pdf>.

¹³ The GAO report stated:

The Navy estimated operating and support costs for LCS seaframes and mission packages in 2009, but the estimates do not fully reflect DOD and GAO best practices for cost estimating and may change due to program uncertainties. GAO’s analysis of the Navy’s 2009 estimates showed that the operating and support costs for seaframes and mission packages could total \$84 billion (in constant fiscal year 2009 dollars) through about 2050. However, the Navy did not follow some best practices for developing an estimate such as (1) analyzing the likelihood that the costs could be greater than estimated, (2) fully assessing how the estimate may change as key assumptions change, and (3) requesting an independent estimate and comparing it with the program estimate. The estimates may also be affected by program uncertainties, such as potential changes to force structure that could alter the number of ships and mission packages required. The costs to operate and support a weapon system can total 70 percent of a system’s costs, and the lack of an estimate that fully reflects best practices could limit decision makers’ ability to identify the resources that will be needed over the long term to support the planned investment in LCS force structure. With a decision pending in 2010 on which seaframe to buy for the remainder of the program, decision makers could lack critical information to assess the full costs of the alternatives.

(Government Accountability Office, *Littoral Combat Ship[:] Actions Needed to Improve Operating Cost Estimates and Mitigate Risks in Implementing New Concepts*, GAO-10-257, February 2010, summary page.)

¹⁴ See, for example, Grace Jean, “Buying Two Littoral Combat Ship Designs Saves the Navy \$600 Million, Official Says,” *NationalDefenseMagazine.org*, January 12, 2011.

Major Program Developments

Growth in Sea Frame Procurement Costs

The Navy originally spoke of building LCS sea frames for about \$220 million each in constant FY2005 dollars. Costs for the first few LCSs subsequently more than doubled. For a detailed discussion of cost growth on the first few LCS sea frames from the FY2007 budget through the FY2012 budget, see **Appendix C**.

2007 Program Restructuring and Ship Cancellations

The Navy substantially restructured the LCS program in 2007 in response to significant cost growth and delays in constructing the first LCS sea frames. This restructuring led to the cancellation of four LCSs that were funded in FY2006 and FY2007. A fifth LCS, funded in FY2008, was cancelled in 2008. For details on the 2007 program restructuring and the cancellation of the five LCSs funded in FY2006-FY2008, see **Appendix D**.

2009 Down Select Acquisition Strategy (Not Implemented)

On September 16, 2009, the Navy announced a proposed acquisition strategy under which the Navy would hold a competition to pick a single design to which all LCSs procured in FY2010 and subsequent years would be built (i.e., carry out a design “down select”).¹⁵ Section 121(a) and (b) of the FY2010 defense authorization act (H.R. 2647/P.L. 111-84 of October 28, 2009) provided the Navy authority to implement this down select strategy. The Navy’s down select decision was expected to be announced by December 14, 2010, the date when the two LCS bidders’ bid prices would expire.¹⁶ The down select strategy was not implemented; it was

¹⁵ The winner of the down select would be awarded a contract to build 10 LCSs over the five-year period FY2010-FY2014, at a rate of two ships per year. The Navy would then hold a second competition—open to all bidders other than the shipyard building the 10 LCSs in FY2010-FY2014—to select a second shipyard to build up to five additional LCSs to the same design in FY2012-FY2014 (one ship in FY2012, and two ships per year in FY2013-FY2014). These two shipyards would then compete for contracts to build LCSs procured in FY2015 and subsequent years.

Prior to the Navy’s announcement of September 16, 2009, the Navy had announced an acquisition strategy for LCSs to be procured in FY2009 and FY2010. Under this acquisition strategy, the Navy bundled together the two LCSs funded in FY2009 (LCSs 3 and 4) with the three LCSs to be requested for FY2010 into a single, five-ship solicitation. The Navy announced that each LCS industry team would be awarded a contract for one of the FY2009 ships, and that the prices that the two teams bid for both the FY2009 ships and the FY2010 ships would determine the allocation of the three FY2010 ships, with the winning team getting two of the FY2010 ships and the other team getting one FY2010 ship. This strategy was intended to use the carrot of the third FY2010 ship to generate bidding pressure on the two industry teams for both the FY2009 ships and the FY2010 ships.

The Navy stated that the contracts for the two FY2009 ships would be awarded by the end of January 2009. The first contract (for Lockheed Martin, to build LCS-3) was awarded March 23, 2009; the second contract (for General Dynamics, to build LCS-4) was awarded May 1, 2009. The delay in the awarding of the contracts past the end-of-January target date may have been due in part to the challenge the Navy faced in coming to agreement with the industry teams on prices for the two FY2009 ships that would permit the three FY2010 ships to be built within the \$460 million LCS unit procurement cost cap. See also Statement of RADM Victor Guillory, U.S. Navy Director of Surface Warfare, and RADM William E. Landay, III, Program Executive Officer Ships, and Ms. E. Anne Sandel, Program Executive Officer Littoral and Mine Warfare, before the Subcommittee on Seapower and Expeditionary Forces of the House Armed Services Committee [hearing] on the Current Status of the Littoral Combat Ship Program, March 10, 2009, pp. 7-8.

¹⁶ The Navy had earlier planned to make the down select decision and award the contract to build the 10 LCSs in the (continued...)

superseded in late-December 2010 by the current dual-award acquisition strategy (see next section). For additional background information on the down select strategy, see **Appendix E**.

2010 Dual-Award Acquisition Strategy (Implemented)

On November 3, 2010, while observers were awaiting the Navy's decision under the down select strategy (see previous section), the Navy notified congressional offices that it was prepared to implement an alternative dual-award acquisition strategy under which the Navy would forego making a down select decision and instead award each LCS bidder a 10-ship contract for the six-year period FY2010-FY2015, in annual quantities of 1-1-2-2-2-2. The Navy stated that, compared to the down select strategy, the dual-award strategy would reduce LCS procurement costs by hundreds of millions of dollars. The Navy needed additional legislative authority from Congress to implement the dual-award strategy. The Navy stated that if the additional authority were not granted by December 14, the Navy would proceed to announce its down select decision under the acquisition strategy announced on September 16, 2009. On December 13, it was reported that the two LCS bidders, at the Navy's request, had extended the prices in their bids to December 30, effectively giving Congress until December 30 to decide whether to grant the Navy the authority needed for the dual-award strategy.

The Navy's November 3 proposal of a dual-award strategy posed an issue for Congress of whether this strategy would be preferable to the down select strategy, and whether Congress should grant the Navy, by December 30, the additional legislative authority the Navy would need to implement the dual-award strategy. On December 14, 2010, the Senate Armed Services Committee held a hearing to review the proposed dual-award strategy. Congress granted the Navy authority to implement the dual-award strategy in Section 150 of H.R. 3082/P.L. 111-322 of December 22, 2010, an act that, among other things, funded federal government operations through March 4, 2011.

On December 29, 2010, using the authority granted in H.R. 3082/P.L. 111-322, the Navy implemented the dual-award strategy, awarding a 10-ship, fixed-price incentive (FPI) block-buy contract to Lockheed, and another 10-ship, FPI block-buy contract to Austal USA. In awarding the contracts, the Navy stated that LCSs to be acquired under the two contracts are to have an average unit cost of about \$440 million, a figure well below the program's adjusted unit procurement cost cap (as of December 2010) of \$538 million (see "Unit Procurement Cost Cap"). The 20 ships to be acquired under the two contracts have a target cost and a higher ceiling cost. Any cost growth above the target cost and up to the ceiling cost would be shared between the contractor and the Navy according to an agreed apportionment (i.e., a "share line"). Any cost growth above the ceiling cost would be borne entirely by the contractor. The Navy stated that, as a worst case, if the costs of the 20 ships under the two FPI contracts grew to the ceiling figure and all change orders were expended, the average cost of the ships would increase by about \$20 million, to about \$460 million, a figure still well below the adjusted cost cap figure of \$538 million.¹⁷

(...continued)

summer of 2010, but the decision was delayed to as late as December 14. (The final bids submitted by the two LCS contractors were submitted on about September 15, and were valid for another 90 days, or until December 14.)

¹⁷ Source: Contract-award information provided to CRS by navy office of Legislative Affairs, December 29, 2010.

The Navy on December 29 technically awarded only two LCSs (one to each contractor). These ships (LCS-5 and LCS-6) are the two LCSs funded in FY2010. Awards of additional ships under the two contracts are subject to congressional authorization and appropriations. The Navy states that if authorization or sufficient funding for any ship covered under the contracts is not provided, or if the Navy is not satisfied with the performance of a contractor, the Navy is not obliged to award additional ships covered under contracts. The Navy states that it can do this without paying a penalty to the contractor, because the two block-buy contracts, unlike a typical multiyear procurement (MYP) contract, do not include a provision requiring the government to pay the contractor a contract cancellation penalty.¹⁸

The Navy's proposed dual-award strategy is broadly similar to a notional dual-award approach that was presented in this CRS report as an option for Congress (see **Appendix E**) since September 27, 2009, when the report was updated to incorporate the Navy's September 16, 2009, announcement of its proposed down select strategy.

For additional background information on the dual-award strategy, see **Appendix F**.

2011 Announced Changes in Mission Module Equipment

The Navy in January 2011 announced changes or potential changes to the composition of LCS mission modules; the sections below summarize these changes.

SUW Module: Griffin Selected as Recommended Replacement for N-LOS

The Navy had planned to use an Army missile program known as the Non-Line of Sight Launch System (NLOS-LS) as part of the LCS surface warfare (SUW) mission package. The Navy planned for LCSs equipped with SUW mission packages to be nominally armed with three NLOS missile launchers, each with 15 missiles, for a total of 45 missiles per ship. The missiles could be used to counter swarm boats or other surface threats.

In May 2010, DOD approved an Army recommendation to cancel NLOS-LS.¹⁹ Following the cancellation of NLOS-LS, the Navy assessed potential alternative systems for fulfilling the NLOS role in the SUW mission package.

On January 11, 2011, the Navy announced that it had selected the Griffin missile as its recommended replacement for NLOS-LS. The Navy stated that Griffin will be about half as expensive as NLOS-LS, and that it could be delivered about as soon as NLOS. The Navy stated that an initial version of the Griffin would be ready by 2014 or 2015, and that a follow-on, longer-ranged version would be ready by 2016 or 2017.²⁰ One press report quoted an official from

¹⁸ Source: Navy briefing to CRS and the Congressional Budget Office (CBO) on December 15, 2010. For a press article on this issue, see Cid Standifer, "FY-11 LCS Contracts On Hold Because Of Continuing Resolution," *Inside the Navy*, March 14, 2011.

¹⁹ "Out of Sight," *Defense Daily*, May 17, 2010: 3. See also Kate Brannen, "U.S. Army Asks to Cancel NLOS-LS," *DefenseNews.com*, April 23, 2010; Jason Sherman, "Army Cancels NLOS-NS, Frees Up Billions For Other Procurement Needs," *Inside the Navy*, April 26, 2010; Sebastian Sprenger, "NLOS-LS Seen As Effective—But To Pricely—In Key Army Analysis," *Inside the Navy*, May 3, 2010.

²⁰ Grace Jean, "Buying Two Littoral Combat Ship Designs Saves the Navy \$600 Million, Official Says," *NationalDefenseMagazine.org*, January 12, 2011; Carlo Munoz, "Navy Pushing Griffin For NLOS-LS Replacement," *Defense Daily*, January 13, 2011; Michael Fabey, "U.S. Navy Identifies New LCS Modules," *Aerospace Daily & (continued...)*

Raytheon, the maker of the Griffin, as stating that the Griffin's current range is less than 5 kilometers (i.e., less than about 2.7 nautical miles).²¹ Another press report stated: "The Griffin's range has not been officially disclosed, though industry experts have reported a range of about 3.5 miles when surface-launched and about nine miles when launched from the air. The NLOS missile had a range of about 25 miles."²²

An April 18, 2011, press report stated that

The Navy may not have settled on the Griffin missile to replace the canceled Non-Line-Of-Sight missile on the Littoral Combat Ship, despite the service's announcement in January that it planned to use the missile for both a short-term and long-term solution to the capability gap...

[Under Secretary of the Navy Robert] Work said that Griffin could be fielded for the first increment of the surface warfare mission package in its current incarnation, which, according to Raytheon, has a range of about 5 kilometers.

However, he said that the longer term solution is less certain.²³

ASW Module: Shift to Systems With "In Stride" Capability

The Navy in January 2011 provided information on changes it has decided to make to the systems making up the ASW module. A January 14, 2011, press report stated that the Navy

discovered that while its [originally planned] LCS ASW module was able to do the mission, the equipment package proved unsatisfactory because the ship would actually have to stop in the water to deploy the equipment. "The ship could not do it in stride," says Capt. John Ailes, Navy mission module program office manager....

As for its ASW defense, the Navy plans to deploy a module that will include three parts: a variable-depth sonar; a multi-functional towed array; and a lightweight towed array, Ailes says. The Navy will be testing the ASW module package throughout this and the coming year, he says, with an eye toward initial operational capability in 2017.²⁴

A January 12, 2011, press report stated:

For the anti-submarine warfare package, the Navy in 2012 expects to receive from Thales a low frequency sonar under development for demonstration and testing purposes. The towed array will provide sailors with a mobile anti-submarine capability. In the meantime, officials are moving ahead with other sensors, including the multifunction towed array for passive

(...continued)

Defense Report, January 14, 2011: 3; Cid Standifer, "Raytheon's Griffin System To Replace NLOS In LCS Mission Package," *Inside the Navy*, January 17, 2011; David Wichner, "New Navy Ships May Use Small Raytheon Missile," *Arizona Daily Star (Tucson)*, January 18, 2011.

²¹ Cid Standifer, "Raytheon's Griffin System To Replace NLOS In LCS Mission Package," *Inside the Navy*, January 17, 2011.

²² David Wichner, "New Navy Ships May Use Small Raytheon Missile," *Arizona Daily Star (Tucson)*, January 18, 2011.

²³ Cid Standifer, "Work: Griffin Missile On Littoral Combat Ship Not A Done Deal," *Inside the Navy*, April 18, 2011.

²⁴ Michael Fabey, "U.S. Navy Identifies New LCS Modules," *Aerospace Daily & Defense Report*, January 14, 2011: 3.

detection and the lightweight tow for torpedo countermeasures and non-acoustic rounds. The intent is to be able to counter enemy diesel submarines in the littorals. “You shift capabilities of the ship from a stationary anti-submarine warfare buried-in system to an in-stride littoral and open-ocean capability when you need it. That puts sensors and sound sources in the fleet in numbers,” said [Rear Admiral Frank C. Pandolfe, director of the Navy’s surface warfare division].²⁵

An April 18, 2011, press report stated that the Navy plans to begin development of the new ASW package in FY2013 and field the system in FY2016.²⁶

MCM Module: Possible Replacement of RAMICS by Modified ALMDS

A January 13, 2011, press report stated:

The Navy is looking to terminate an underperforming anti-mine system from the LCS mission package being designed for that mission.

Service acquisition officials have become increasingly frustrated with the testing results of the Rapid Airborne Mine Clearance System (RAMCS), Rear Adm. Frank Pandolfe, head of the Navy’s surface warfare directorate, said this week.

While testing is still underway on the Northrop Grumman [NOC] system, which is to locate and destroy mines in shallow waters, the results have fallen short of service expectations, he said during a Jan. 11 speech at the Surface Navy Association’s annual conference in Arlington, Va.

To remedy the situation, Pandolfe said program officials are looking to modify the Airborne Laser Mine Detection System (ALMDS) to carry out the RAMCS mission.

Also manufactured by Northrop Grumman, the ALMDS uses directed energy system mounted on board a MH-60R helicopter to detect mines at the same shallow depth the RAMCS was designed to destroy.

If the modification is successful, Navy decisionmakers plan to ax the RAMCS platform and use the ALMDS variant, Pandolfe said.

The surface warfare chief did not go into specifics regarding what kind of development work would be necessary to make such a transition, but he did note the move would also trim costs on the growing costs on the LCS anti-mine package.

However, Pandolfe reiterated that if the Navy opts to go with the ALMDS approach, the mission package itself would be delivered on time.

“They will be where they need to be when they need to be there,” he said.²⁷

²⁵ Grace Jean, “Buying Two Littoral Combat Ship Designs Saves the Navy \$600 Million, Official Says,” *NationalDefenseMagazine.org*, January 12, 2011.

²⁶ Cid Standifer, “Navy Ditches Old LCS ASW Package, Will Field New Package In FY-16,” *Inside the Navy*, April 18, 2011.

²⁷ Carlo Munoz, “Navy Looks To Cut Anti-Mine System From LCS Mission Package,” *Defense Daily*, January 13, 2011. Material in brackets as in original. A January 12, 2011, press report similarly stated that

A key technology [for the MCM module], the remote mine hunting vehicle, a diesel-powered semi-
(continued...)

FY2012 Funding Request

Under Navy budget plans, the four LCSs that the Navy wants to procure in FY2012 are to receive \$79.5 million in prior-year advance procurement (AP) funding. Navy's proposed FY2012 budget requests \$1,802.1 million in FY2012 procurement funding to complete the four ships' combined estimated procurement cost of \$1,881.6 million. The Navy's proposed FY2012 budget also requests \$79.6 million procurement funding for procurement of LCS mission packages, and \$286.8 million in research and development funding for the LCS program.

Issues for Congress

Lack of Economic Order Quantity (EOQ) Authority for Executing the Block-Buy Contracts

The provision that granted the Navy the authority to implement a dual-award acquisition strategy for the LCS program—Section 150 of the Continuing Appropriations and Surface Transportation Extensions Act, 2011 (H.R. 3082/P.L. 111-322)—did not include wording explicitly permitting the Navy to use economic order quantity (EOQ) purchasing in procuring the 20 LCSs covered under the two 10-ship LCS block-buy contracts. (EOQ authority comes automatically with grants of authority for multiyear procurement [MYP] arrangements,²⁸ but needs to be explicitly included in provisions that grant authority for block-buy contracts.)

One option for Congress, in marking up the Navy's proposed FY2012 budget, would be to include a provision explicitly permitting the Navy to use EOQ purchasing in procuring the 20 LCSs covered under the two 10-ship block-buy contracts. Granting the Navy EOQ authority for the two LCS block-buy contracts would permit the Navy to bring forward certain long-leadtime components of many of these 20 LCSs and procure them all at once, in batch fashion (i.e., order them in an economic quantity), during the earlier years of the block-buy contracts. This could reduce the production costs of these components and thereby reduce the total procurement costs of many of these 20 LCSs. Since EOQ purchasing would shift the procurement of certain LCS sea frame components from later years of the two block-buy contracts to earlier years, funding these EOQ purchases would increase LCS sea frame procurement funding requirements in the

(...continued)

submersible that will tow the AQS-20 sonar, is behind schedule.

"Reliability of the system is about 80 percent of where we need to be," [Rear Admiral Frank C. Pandolfe, director of the Navy's surface warfare division] said. But he remains confident that the system will pull through. The rapid airborne mine clearance system, or RAMICS, a cannon designed to destroy mines floating below the surface in deep water, is not performing well in tests. Navy officials are looking to adapt the airborne mine neutralization system, which kills mines at the bottom of the ocean, for the mission. Preliminary testing is showing promise, and if it works, then the Navy may not need RAMICS, Pandolfe said.

"That would allow us to streamline the program, save money and go to a single kill vehicle," he said. When the legacy mine sweeping force starts leaving the fleet in 2017, the Navy will be ready to introduce the LCS systems, he said.

(Grace Jean, "Buying Two Littoral Combat Ship Designs Saves the Navy \$600 Million, Official Says," *NationalDefenseMagazine.org*, January 12, 2011.)

²⁸ EOQ authority is included in 10 USC 2306b, the law governing MYP arrangements.

earlier years of the two block-buy contracts, and reduce (by an even larger amount) LCS sea frame procurement funding requirements in the later years of the two LCS block-buy contracts.

Announced Changes in Mission Module Equipment

One potential oversight question for Congress concerns the changes and potential changes in LCS mission module equipment announced by the Navy in January 2011 (see “2011 Announced Changes in Mission Module Equipment” in “Background”). Potential oversight questions for Congress include the following:

- How will the announced changes in the equipment making up the SUW and ASW modules affect the Initial Operational Capability (IOC) dates of these modules?
- How would the replacement of the NLOS-LS missile by the Griffin missile in the SUW module affect the SUW capability of the LCS, particularly in light of the range of the Griffin missile compared to that of the NLOS-LS missile?
- When does the Navy anticipate announcing its decision on whether to keep the Rapid Airborne Mine Clearance System (RAMICS) in the MCM module or replace it with a modified version of the Airborne Laser Mine Detection System (ALMDS)? If RAMICS were replaced by a modified version of ALMDS, how would that affect the IOC date of the MCM module and the MCM capability of the LCS?

Combat Survivability

Another potential oversight issue for Congress for the LCS program concerns the combat survivability of the LCS.

General

December 2010 DOT&E Report

A December 2010 report from DOD’s Director of Operational Test and Evaluation stated:

[On LCS-1,] Critical ship control systems essential to support the crew have performed well in testing; however, several systems required for self-defense and mission package support have demonstrated early reliability problems....

LCS is not expected to be survivable in terms of maintaining a mission capability in a hostile combat environment. This assessment is based primarily on a review of the LCS design requirements. The Navy designated LCS a Survivability Level 1 ship; the design of the ship just allows for crew evacuation. Consequently, its design is not required to include survivability features necessary to conduct sustained operations in a combat environment. The results of early live fire testing using modeling and simulation, while not conclusive, have raised concerns about the effects weapons will have on the crew and critical equipment. Additional live fire testing and analysis is needed to fully assess the survivability of the LCS

class of ships. Additional information is available in the classified LCS 1 Early Fielding Report.²⁹

March 9, 2011, Hearing Before House Appropriations Committee Defense Subcommittee

At a March 9, 2011, hearing on the Navy's proposed FY2012 budget before the Defense subcommittee of the House Appropriations Committee, the following exchange took place concerning LCS survivability:

REPRESENTATIVE JAMES MORAN: I'd like to ask questions about the Littoral Combat Ship and the Aegis Combat System. Perhaps the best directive that Admiral Roughead—either of our other distinguished witnesses may want to chime in as well—we know that the LCS is designed to fight in littoral waters, where larger surface and subsurface ships can't safely navigate.

But according to the Pentagon's (inaudible) report that just came out in the last two or three months, the Department of Operational Tests and Evaluations, and I quote, "The LCS design is not required to include survivability features necessary to conduct sustained operations in the combat environment."

So I have to ask, why are we buying 55 of these surface combatants if they're not designed to survive in a hostile combat environment? I don't understand how we can justify that. What other warfighter need does the LCS program satisfy if the ships are not designed to survive in a combat environment? Admiral?

CHIEF OF NAVAL OPERATIONS ADMIRAL GARY ROUGHEAD: Yes, sir. And I would submit that as you look at the levels of survivability that we have in our ships today, that the Littoral Combat Ship is not as hard and tough a ship, for example, as one of our guided missile destroyers. But it still possesses levels of survivability and redundancy that allow it to go into hostile environments. And so, there are varying degrees as to how we grade them. And LCS, in concert with the rest of the fleet, I believe is going to be a very key component of our ability to operate in the military.³⁰

April 29, 2011, Navy Briefing

At the request of CRS and CBO, the Navy on April 29, 2011, briefed CRS and CBO on the issue of LCS combat survivability. The Navy's briefing slides from that briefing are reproduced below.

²⁹ Department of Defense, Director, Operation Test and Evaluation, *FY 2010 Annual Report*, December 2010, pp. 144-145.

³⁰ Source: Transcript of hearing. For a press article discussing this exchange, see Andrew Burt, "CNO Defends Littoral Combat Ship's Role In Fleet Despite Low Survivability," *Inside the Navy*, March 14, 2011.



Littoral Combat Ship (LCS)



LCS Survivability



April 29, 2011



CAPT Jeff Riedel
Program Manager



LCS Survivability



- ♦ Ship built to meet JROC-approved survivability requirements
- ♦ OPNAVINST 9070.1 Level 1 Survivability standards - “provide for EMP and shock hardening, individual protection for Chemical, Biological, Radiological (CBR) defense, including decontamination stations, DC/FF capability to control and recover from conflagrations...”
- ♦ LCS design includes Level 1 plus tailored survivability enhancements (“Level 1+”), such as:
 - Electro-magnetic pulse (EMP) hardening
 - Individual Chemical, Biological, Radiological protection with decontamination stations
 - Shock hardening of damage control (DC) and propulsion systems
 - Redundant, automated firefighting systems
 - Select fragmentation armor
 - Ability to survive in sea state 8
- ♦ LCS survivability depends on a combination of ship design and ship CONOPS

2



LCS CONOPS



- ♦ **Operate as part of a networked battle force**
 - Independent ops only in low to medium threat scenarios
 - Part of a networked battle force ops in high threat environments
- ♦ **Avoid being hit**
 - Speed
 - Reliance on overboard systems
- ♦ **Fight and survive if hit**
 - Ship design: Accept ship mission kill; keep ship afloat and protect crew after hit
 - Battle force design: Maintain battle force fight-through capability through LCS numbers and mission flexibility
- ♦ **Withdraw/reposition if hit**
 - Campaign Measure Of Effectiveness (MOE)

Ship Design And CONOPS Emphasizes Speed, Numbers, And Mission Flexibility In Lieu Of Platform Weight And Cost

3



Operating Environment



- ♦ **LCS designed for small combatant ops in littorals**
 - Replaces PC, MCM, and FFG classes
 - Presence, maritime security ops
 - Patrol, maritime interdiction ops
 - Littoral ASuW (small boats), ASW (diesels)
 - Mine countermeasures
 - Special operations forces support
- ♦ **LCS operates in low-to-medium threat environments during independent littoral operations**
 - Ship's gun overmatches individual small boat threat
 - Missile self-defense system designed to counter ambush attacks
- ♦ **In high intensity combat operations, LCS relies on complementary assets for protection while conducting critical missions**
 - Similar to PCs, MCMs, FFGs, Amphibs, P-3s
 - Missile self-defense systems designed only to counter leakers



LCS Design And CONOPS Reflect Navy's New Networked Battle Force Design

4



Avoiding a Hit



- ♦ **Sprint speed of 40+ knots is integral to avoiding a hit:**
 - Complicates enemy targeting
 - Allows quick repositioning against threats
 - Torpedo evasion
- ♦ **Active and Passive defenses**
 - 57 mm gun
 - Rolling Airframe Missiles (RAM and SeaRAM)
 - Chaff
- ♦ **Reliance on off-board systems helps keep ship out of harm's way**
 - e.g., ship remains outside of minefield
- ♦ **Multiple LCSs operating together**
 - Provide mutual cooperation and enhanced effectiveness against multiple or different threats (e.g., one ship conducting counter mine operations, while another providing counter small boat protection)

Combination Of High Speed, Active And Passive Defenses And Off-Board Systems Very Effective

5



Surviving And Fighting If Hit



- ♦ **LCS has select fragmentation armor protection to enable sustained combat operations**
 - LCS damage control/firefighting has multiple installed automatic and remote firefighting systems to control shipboard fires
- ♦ **LCS ship structure is designed to minimize cascading flooding damage after a major hit**
 - Shock-hardened hull keeps ship afloat with 15 percent damaged length, 3-compartment flooding
- ♦ **Modular mission packages may continue mission functionality after hit**
 - E.g., 30mm cannon can operate on battery power
- ♦ **Distributed LCS design architecture allows battle force mission accomplishment despite individual LCS ship damage**
 - Loss of a single LCS means the battle force loses only one mission set
 - Surviving LCSs can reconfigure their mission packages as necessary

Additional Ship Systems Redundancy And Protection Would Require Increased Weight And Expense

6



Repositioning After Hit



- ♦ **LCS is designed to:**
 - Maintain essential mobility after a hit
 - Allow ship to exit battle area under its own power
- ♦ **LCS systems allow ship's crew to navigate and communicate while repositioning after a hit**
- ♦ **While mission loss is a tactical-level MOE, ship loss is a campaign-level MOE**
 - Early "Streetfighter" CONOPS called for ships to be abandoned after a hit
 - LCS CONOPS focuses on crew safety and ship survival



7



Summary



- ♦ **Meets JROC-approved survivability requirements**
- ♦ **Achieves Navy "Level 1+" survivability criteria**
- ♦ **Incorporates survivability systems to perform required missions in littoral with emphasis on crew survival**
- ♦ **Utilizes speed, numbers, and CONOPS as force multipliers**



LCS Survivability Supports Ship, Crew, And Mission

8

November 2004 CBO Report

A November 2004 CBO report states:

The concept of survivability as it relates to Navy ships rests on three features: susceptibility, vulnerability, and recoverability. Susceptibility is a ship's ability to avoid an enemy strike, or its probability of being hit. Vulnerability is the ship's ability to withstand the strike, or its probability of being destroyed if hit. Recoverability is the ability of the crew to restore a ship's systems so the ship can carry out its missions while damaged. Key determinants of survivability include, among other things, a ship's defensive systems, the way it is constructed, and the resources on board the ship to redress damage.

In designing and building ships, all three of those concepts must be balanced. For example, a vessel that had zero susceptibility when its defensive systems were engaged but that had had little attention paid to reducing its vulnerability would be subject to crippling attack when its defenses were down, such as when it was on a nonalert status in a foreign port. Conversely, a ship that was built to withstand almost any kind of attack would most likely be too heavy, costly, and slow to be effective in combat situations.

The Navy divides its surface ships into three broad survivability categories that reflect the environments in which they are expected to function: Level I, Level II, and Level III. Ships built to Level I are expected to operate in the least severe environment, away from the area where a battle group is operating or the general war-at-sea region. Those vessels should be able to maintain good handling in bad weather and should have systems for fighting fires on board the ships, hardening against electromagnetic pulses, and protection against chemical, biological, or radiological contamination. However, they are not expected to "fight hurt," as the Navy puts it. Such ships include material support ships, mine-warfare vessels, and patrol combatants.

Ships built to Level II are expected to operate in a more severe environment, such as in support of a battle group in the war-at-sea region. Level II survivability should include the capacity to continue fighting even if the ship is hit by enemy weapons. Such ships would have all of the features of Level I but more redundancy in their primary and support systems, better structural integrity and compartmentalization (such as being built with numerous watertight sections), protection against conventional and nuclear blasts, and a smaller signature (meaning they have a smaller radar cross-section, make less noise when passing through the water, and are less susceptible to mines). Ships built to Level II include the logistics support ships that supply materials, fuel, and ammunition to carrier battle groups and amphibious warfare ships during combat.

Level III is the most severe environment envisioned for surface warships. Vessels designed to withstand that environment should have all of the features of ships designed to Level II as well as better defensive systems and more ability to deal with the degrading effects of hits from antiship cruise missiles, torpedoes, and mines (through better damage-control systems and greater structural integrity). Ships built to Level III specifications include aircraft carriers and major surface combatants, such as Aegis-capable cruisers and destroyers.³¹

³¹ Congressional Budget Office, *The Future of the Navy's Amphibious and Maritime Prepositioning Forces*, November 2004, p. 25. In a footnote to this passage, the CBO report states that "This discussion comes almost entirely from Department of the Navy, Chief of Naval Operations, Ship Safety and Survivability Office, *Survivability Design Handbook for Surface Ships* (September 2000)."

OPNAVINST 9070.1 of September 23, 1988

Enclosure 2 (pages 9 and 10) of OPNAVINST (Office of the Chief of Naval Operations Instruction) 9070.1 of September 23, 1988, on survivability policy for Navy surface ships,³² states:

DEFINITION OF SURVIVABILITY LEVELS FOR SURFACE SHIPS

Survivability weapons effects and operational environments are categorized in terms of the three levels of severity described below. They provide a basis for establishing survivability performance standards and are not intended to describe conditions of readiness or mission impact. Definitive engineering design values shall be developed to characterize the degrees of severity relative to the weapons effects identified in enclosure (1). Ship survivability features shall provide affordable protection at the levels specified in enclosure (3) to support sustained mission capability:

Level I - low
Level II - moderate
Level III - high

Level I represents the least severe environment anticipated and excludes the need for enhanced survivability for designated ship classes to sustain operations in the immediate area of an engaged Battle Group or in the general war-at-sea region. In this category, the minimum design capability required shall, in addition to the inherent sea keeping mission, provide for EMP and shock hardening, individual protection for CBR, including decontamination stations, the DC/FF capability to control and recover from conflagrations and include the ability to operate in a high latitude environment.

Level II represents an increase of severity to include the ability for sustained operations when in support of a Battle Group and in the general war-at-sea area. This level shall provide the ability for sustained combat operations following weapons impact. Capabilities shall include the requirements of Level I plus primary and support system redundancy, collective protection system, improved structural integrity and subdivision, fragmentation protection, signature reduction, conventional and nuclear blast protection and nuclear hardening.

Level III, the most severe environment projected for combatant Battle Groups, shall include the requirements of Level II plus the ability to deal with the broad degrading effects of damage from anti-ship cruise missiles (ASCMs), torpedoes and mines.

³² OPNAVINST 9070.1, September 23, 1988, entitled "Survivability Policy for Surface Ships of the U.S. Navy," 10 pp., accessed on April 29, 2011, at <http://doni.daps.dla.mil/Directives/090000%20General%20Ship%20Design%20and%20Support/09-00%20General%20Ship%20Design%20Support/9070.1.pdf>. The home page at <http://doni.daps.dla.mil/default.aspx>, entitled "Department of the Navy Issuances," states that it is a "digital collection of unclassified issuances released by the Secretary of the Navy [and] Chief of Naval Operations." EMP is electromagnetic pulse; CBR is chemical, biological, radiological; DC/FF is damage control / firefighting; TLRs is top level requirements.

SURVIVABILITY PROTECTION REQUIREMENTS
BY SHIP CLASS

The operationally relevant ship survivability protection requirements presented below incorporate the severity levels and conditions described in enclosure (2) and shall be implemented in concert with applicable TLRs and associated design standards and performance specifications.

PROTECTION REQUIREMENTS
BY SHIP CLASS

SHIP CLASS	NUCLEAR/CONVENTIONAL WEAPON PROTECTION LEVELS		CBR PROTECTION LEVELS	NUCLEAR/ CONVENTIONAL PROTECTION LEVELS (1)
	SHIP	EQUIPMENT	SHIP	PERSONNEL
<u>AIRCRAFT CARRIERS</u>	III	III	III	III
<u>BATTLE FORCE SURFACE COMBATANTS</u>	III	III	III	III
<u>FRIGATES</u>	II	II	II	II
<u>AMPHIBIOUS WARFARE SHIPS</u>	II	II	II	II
<u>UNDERWAY REPLENISHMENT STATION SHIPS</u>	II	II	II	II
<u>SHUTTLE SHIPS</u>	I	I	I	I
<u>PATROL COMBATANT AND MINE WARFARE SHIPS</u>	I	I	I	I
<u>NAVAL STRATEGIC SEALIFT</u>	I	I	I	I
<u>MATERIAL SUPPORT SHIPS</u>	I	I	I	I
<u>ALL OTHER AUXILIARY SHIPS/CRAFT</u>	I	I	I	I

NOTE: (1) Personnel hazard environments include fragments and debris, thermal radiation, initial and residual nuclear radiation, chemical and biological agents, temperature extremes, fire, smoke and toxic products of combustion and laser irradiation.

Shock Testing

March 9, 2011, Hearing Before House Armed Services Committee Seapower and Projection Forces Subcommittee

At a March 9, 2011, hearing on Navy shipbuilding programs before the Seapower and Projection Forces subcommittee of the House Armed Services Committee, the following exchange took place concerning LCS survivability:

REPRESENTATIVE HANK JOHNSON: I'm concerned that we may be prioritizing quantity at the expense of quality particularly given our short-term focus on light ships designed for use in coastal waters. I'm concerned about unresolved questions regarding survivability of the LCS....

Secretary Stackley, for years the Director of Operational Testing and Evaluation has raised serious concerns regarding survivability of the littoral combat ship and whether the LCS meets its Level 1 survivability requirement, why are LCS full ship shock tests not scheduled until Fiscal Year '14 when we will already have produced 10 or 12 ships? And why would we begin full-scale production of the ship if there are serious outstanding concerns regarding its survivability?

ASSISTANT SECRETARY OF THE NAVY FOR RESEARCH DEVELOPMENT AND ACQUISITION SEAN STACKLEY: Yes, sir. Let me first by describing LCSs. LCS-1 and 2 are both designed to Level 1 level of survivability. And all the analysis and testing to date supports the determination that they in fact meet their survivability requirements. The scheduling of the full ship shock trial on LCS in 2014 is about right compared to all other shipbuilding programs.

In fact, typically, in a major shipbuilding program, you don't shock the lead ship, you end up shocking one of the first follow ships. So, for example, the last major shipbuilding program that we conducted shock trials on, the DDG-51, the first ship to be shocked was DDG-53, which wasn't delivered until two years after the 51. And by the time she was shocked, we had about 20 DDG 51s under contract in a full rate production.

The nature of the beast in shipbuilding is that you have such a large capital intense structure that's building these ships, that you cannot afford to stop construction and wait for the lead ship to be built, tested, and then get around to a full ship shock before you start construction again.

So what we do is we address to the extent possible through analysis and surrogate testing and developmental testing, proof out the design so that by the time we get to the shock trial, the risk has been retired.

And in fact, if you go back and look at the results from prior full ship shock trials, the change activity that's driven into those ship's designs is relatively minimal because we have in fact spent so much time on the front end of the design to retire that risk. And we see the same case here for LCS.³³

³³ Source: Transcript of hearing.

Navy Information Paper Provided to CRS on April 29, 2011

On April 29, 2011, the Navy provided to CRS an information paper on LCS shock testing that stated:

The LCS FSST [Full Ship Shock Trial] plan is similar to the FSST plans of the DDG 51 ARLEIGH BURKE Class destroyers and the LPD 17 SAN ANTONIO Class amphibious ships, where the Navy conducted the FSST on the third ships of the class, USS JOHN PAUL JONES (DDG 53) and USS MESA VERDE (LPD 19) respectively.

There are several reasons supporting the Navy's plan to conduct a Full Ship Shock Trial (FSST) on later ships of the LCS Class. First, the follow (LCS 3 and forward) LCS Class ships incorporate the Flight 0+ Capability Development Document (CDD) and will be more representative of the ships of the class. These ships are incorporating lessons learned from LCS 1 and 2 and the early deployment of USS FREEDOM (LCS 1). Second, the Navy is conducting individual component and system level shock tests that must complete prior to conducting the FSST. The Navy must also complete the modeling and simulation to support initial survivability assessments and to help determine the test event geometry and charge size for the FSST. Lastly, preparation and completion of the environment assessment takes several years to complete; it is on track to support the current FSST schedule approved by the Director, Operational Test and Evaluation (DOT&E) as part of the review of the LCS Test and Evaluation Master Plan (TEMP).

There is currently no particular "long pole in the tent", environmental impact studies, or otherwise for LCS FSST. The Navy is executing a methodical plan approved by OSD for the LCS Class. This plan will accommodate the December 2010 dual block buy award of two LCS seaframe variants.³⁴

Hull Cracking on LCS-1

Another potential oversight issue for Congress for the LCS program concerns hull cracking on LCS-1. A March 18, 2011, press report states that LCS-1

developed a crack as long as six inches through its hull during sea trials, prompting a U.S. Navy investigation of the design.

The Navy is analyzing the crack to determine if changes are required for future Lockheed Martin hulls, Naval Sea Systems Command spokesman Christopher Johnson said yesterday in an e-mail. This includes reviewing "the design, construction drawings and welding procedures," he said.

During a heavy-weather ocean trial on the USS Freedom in mid-February, he said, sailors discovered a six-inch horizontal hull crack below the waterline that leaked five gallons an hour. Inside the hull the crack measured three inches. It originated in a weld seam between two steel plates.

The ship returned to its home port in San Diego, avoiding rough seas, after the commanding officer judged the leak rate "manageable," Johnson said.

³⁴ Source: Navy information paper on LCS Full Ship Shock Trial (FSST) planning dated February 15, 2011, and provided by the Navy to CRS on April 29, 2011.

Smaller cracks that indicated welding “defects” showed up in the welds of the vessel’s aluminum structure during sea trials last year, Johnson said in his e-mail.

Initial analysis of the second Lockheed-built vessel, the USS Independence, showed improved welding, he said.

A spokesman for Lockheed Martin, Keith Little, said the company “is working closely with the Navy to confirm the root cause” and has made all necessary repairs to the ship. “We are also supporting the Navy in additional testing along the hull to confirm this crack was an isolated anomaly,” Little said....

Johnson said in his e-mail that repair of the hull crack was completed March 12....

Johnson said that several years ago the Navy conducted an “early fatigue analysis” on the Freedom that “identified high-stress areas” in the aluminum superstructure. The areas were fitted with instruments to collect data and to monitor for cracks.

Cracks showed up late last year in the predicted areas. The measuring instruments remain in place, and the Navy implemented some design changes to the superstructure “to correct high stress and fatigue issues,” Johnson said.³⁵

An April 12, 2011, press report states:

Navy officials looking into an incident in which cracking developed on portions of the Lockheed Martin [LMT]-version of the Littoral Combat Ship have ruled out design flaws as a cause, according to a senior company official.

Program officials were notified by Naval Sea Systems Command “a couple of weeks” ago that the LCS design of the Lockheed Martin variant was not to blame for the cracks, Joe North, vice president of the company’s Littoral Ship Systems, said during an April 8 briefing with reporters at the company’s offices in Arlington, Va. Navy review of structural cracks on the USS Freedom (LCS-1) is still under review, he added.

“It certainly is not design,” he said regarding the Navy review. “So, now we are looking at was it [caused] by stresses under the way [the Navy] went through the heavy sea testing, or was it potentially a flaw in the weld that got through.”

North added, “It could be [caused] from ... a workmanship issue. You can [just] imagine the number of miles of welds on a ship.”

In February, the Navy was forced to suspend heavy sea trials on the LCS-1 after a three- to six-inch crack in the ship’s hull developed during the trials. In addition to the hull cracks, structural anomalies were also found in the ship’s main superstructure, according to North.

Since the suspension of sea tests for LCS-1, service officials have been reviewing the incident, with Lockheed Martin officials supporting the investigation by supplying the Navy with technical information, North said.

³⁵ Tony Capaccio, “Lockheed NMartin’s First Littoral Combat Ship Cracks, Navy Says,” *Bloomberg News*, march 18, 2011.

“What we have done, basically, is re-run our models and fed them the data, the engineering basis for everything we have looked at,” he said. “So, they are taking that, plus their own assessments and they are controlling the overall assessment of the ship.”

He could not comment on when the Navy review of the incident will be complete, but noted that company officials have already begun to address some of the issues that led to the cracking on LCS-1 on the new LCS-3 ship, which is now under construction at Marinette Marine shipyards in Wisconsin.

“What we have done on [LCS]-3 ... from a producability standpoint, is [ask] how can we make this better, the second time around,” North said.

To that end, North acknowledged that in “some very small areas” on LCS-1 where program officials found it difficult to get a “full-penetration weld” employees would “be forced to try and get a hand in” and get a solid weld.

“So we corrected those [areas] in [LCS]-3 going forward, so that we get full capability ... and completely make sure up front that everything is done,” he said.

While the hull cracking took Navy and Lockheed Martin officials by surprise, the cracks on the boat’s superstructure “were predicted,” North said, adding they are “more of a nuisance issue that occurs.” The superstructure on board LCS-3 has also been corrected to address the flaws in LCS-1.³⁶

Technical Risk

Another potential oversight issue for Congress concerns the amount of technical risk in the program. The discussion below addresses this issue first with respect to the LCS sea frame, and then with respect to LCS mission packages.

Sea Frame

Regarding technical risk in developing and building the LCS sea frame, a March 2011 GAO report stated:

Technology Maturity

Sixteen of 19 critical technologies for both LCS designs are mature. Three technologies—LCS 1’s overhead launch and retrieval system and LCS 2’s trimaran hull and aluminum structure—are nearing maturity. Further, launch, handling, and recovery systems, which are essential to the LCS antisubmarine warfare and mine countermeasures missions, are still being refined for both designs. For LCS 1, Navy simulations have identified risks in safely launching and recovering mission systems that experience pendulous motion during handling—such as the remote multimission vehicle and unmanned surface vehicle systems. These operations may be complicated by unacceptably high water levels intruding into the ship’s launch bay during high sea states. On LCS 2, the twin boom extensible crane

³⁶ Carlo Munoz, “Lockheed Martin: Navy Rules Out Design Flaws As cause For LCS Cracks,” *Defense Daily*, April 12, 2011. See also Cid Standifer, “Lockheed: LCS-1 Crack Caused By Faulty Welding, Not A Design Flaw,” *Inside the Navy*, April 11, 2011, and Michael Fabey, “Welds Implicated In LCS Cracks,” *Aerospace Daily & Defense Report*, April 11, 2011: 3.

system—designed to launch, handle, and recover watercraft—contains unproven elements. The Navy reports recent progress on these systems including (1) successful operation and movement of an embarked 11-meter rigid-hull inflatable boat onboard LCS 1 in March 2010, (2) synthetic lift lines on LCS 2 successfully completing a 200 percent lift test, and (3) routine usage of a straddle carrier to move an 11-meter rigid-hull inflatable boat (with stowage cradle) and berthing modules around the LCS 2 mission bay. Navy officials also report that testing of LCS 2's twin-boom extensible crane is progressing.

Design and Production Maturity

The Navy provided historical data on design completeness that was inconsistent with data it provided to GAO last year, but officials did not respond to requests for clarification. The data provided by the Navy last year indicated that the LCS 3 and LCS 4 began fabrication with only 69 percent and 57 percent of basic and functional drawings complete, respectively. The Navy also could not provide this data for the LCS 1 and LCS 2. GAO's work on shipbuilding best practices has found that leading commercial firms assess a ship design as stable when 100 percent of these drawings are complete. By delaying construction start until basic and functional design is completed and a stable design is achieved, shipbuilders minimize the risk of design changes and the subsequent costly rework and out-of-sequence work these changes can drive.

The Navy used a concurrent design-build strategy for LCS 1 and LCS 2 seaframes, which proved unsuccessful. Implementation of new design guidelines, delays in major equipment deliveries, and strong focus on achieving schedule and performance goals resulted in increased construction costs. The Navy's ongoing efforts to resolve technical issues affecting LCS 1 and LCS 2, implement cost reduction measures, and increase mission capability have led to design changes for LCS 3 and LCS 4. These changes are significant and have affected the configuration of several major ship systems including propulsion, communications, electrical, and navigation....

Program Office Comments

According to the Navy, two industry teams (1) have each designed, built, and delivered to the Navy a lead ship meeting the LCS performance requirements and (2) are currently building their second ships, with lessons learned from the lead ships incorporated into the designs. The Navy states that both designs are stable, with LCS 3 and LCS 4 having experienced minimal design changes to-date, and cites impressive learning and investment by both shipbuilders as well as significant improvement in cost and schedule performance. According to the Navy, LCS 3 launched on December 4, 2010, at over 80 percent complete. This level of completeness at launch, and the improvement in cost and schedule performance by both shipbuilders, provides the Navy confidence that risk of design change and out-of-sequence work is minimal. The Navy also provided technical comments, which were incorporated as appropriate.³⁷

Mission Packages

Regarding technical risk in developing the modular mission packages for the LCS, a March 2011 GAO report stated:

³⁷ Government Accountability Office, *Defense Acquisitions[:] Assessments of Selected Weapon Programs*, GAO-11-233SP, March 2011, p. 98.

Technology Maturity

At its full baseline capability, operation of the MCM, SUW, and ASW packages on LCS requires a total of 21 critical technologies, including 11 sensors, 6 vehicles, and 4 weapons. Of these technologies, 18 are mature and have been demonstrated in a realistic environment.

The Navy has accepted delivery of two partially capable MCM mission packages. According to program officials, in 2010 the MCM mission package completed end-to-end testing, and two MCM systems—the AN/AQS-20A sonar and Airborne Laser Mine Detection System—have completed developmental testing in separate test events. Two other systems—the Unmanned Surface Vehicle (USV) and Unmanned Surface Sweep System—have not yet been demonstrated in a realistic environment, and a third—the Remote Minehunting System (RMS)—has been delayed because of poor reliability. Program officials report that the Navy is assessing alternative USV designs because the current system does not meet power output requirements necessary to support the towed surface sweep system. The RMS, which is its own major defense acquisition program, experienced a Nunn-McCurdy unit cost breach of the critical threshold in December 2009, due to cost increases resulting from a 51 percent reduction in quantity and efforts to improve reliability. In June 2010, the Office of the Secretary of Defense completed its review and certified RMS for continuation. According to Director, Operational Test and Evaluation, officials, RMS reliability has improved from 7.9 hours to nearly 45 hours between failures. According to program officials, the Navy plans to recommence RMS production in fiscal year 2015. Further, program officials report that the Rapid Airborne Mine Clearance System has been removed from the package while the Navy evaluates more cost-effective alternatives for meeting desired capability delivery time frames.

The Navy has accepted delivery of two partially capable SUW mission packages and expects to accept delivery of a third mission package in fiscal year 2011. The Navy will resume procuring SUW packages in fiscal year 2012. The 30 millimeter gun was test-fired from LCS 1 in September 2009 and according to program officials, integrated with the LCS 1 combat system and demonstrated at sea in April 2010. In May 2010, DOD cancelled the Non-Line-of-Sight Launch System due to cost and technical challenges. Officials note the Navy is evaluating other alternatives and expects to complete evaluation by the second quarter of fiscal year 2011.

The Navy accepted delivery of one partially capable ASW mission package in September 2008. However, program officials stated that the Navy plans to introduce new mission systems and classified capabilities before procuring additional ASW packages. Program officials report that the Navy has completed development and testing of the first ASW mission package to evaluate operational concepts and refine requirements.

Other Program Issues

The Navy plans to purchase 18 ships and 13 mission packages between fiscal years 2011 and 2015, but developmental delays in key mission package systems mean the Navy will acquire significant numbers of seaframes before mission packages are proven. GAO has reported since 2007 on challenges developing systems constituting LCS mission packages and integrating them with their host platforms. These challenges have delayed the planned delivery of baseline capability by several years. Until mission package performance is proven, the Navy risks investing in a fleet of ships that does not deliver its promised capability and is largely constrained to self-defense as opposed to mission-related tasks.

Program Office Comments

The Navy stated that recent testing has been comprehensive, operationally relevant, and successful. According to the Navy, the SUW mission package supported early deployment of LCS 1, providing a counter-illicit trafficking capability. Further, the Navy stated that from program inception, the acquisition strategy for mission package has employed an incremental approach and remained stable, fielding systems as they achieve the required level of maturity. According to the Navy, those few systems experiencing issues (NLOS-LS and RMS) are either being replaced with alternative systems or are targets of increased focus and attention. According to the Navy, the results have been positive in all cases. In addition, the Navy provided technical comments, which were incorporated as appropriate.³⁸

An April 26, 2010, news report stated:

The Littoral Combat Ship program lacks a “timely” test program plan for the mission packages slated to deploy aboard the vessels, putting the effort at a “medium” risk for cost increases ... according to a new study by the Pentagon’s acquisition directorate....

“The program has major integration challenges between seaframes and MPs’ [mission packages],” the study states. “To address this issue, the program established an Integrated Product Team ... the team has identified numerous deficiencies and verified corrections within each seaframe.”³⁹

Total Program Acquisition Cost

Another potential oversight issue for Congress for the LCS program concerns the lack of an official DOD estimate of the program’s total acquisition (i.e., research and development plus procurement) cost. Although DOD’s December 31, 2010, SAR for the LCS program provides an estimated total acquisition cost for 55 LCS sea frames (see “Estimated Acquisition Cost” in “Background”), DOD has not reported a total estimated acquisition cost for the entire LCS program, including costs for both 55 LCS sea frames and 64 LCS mission packages.

Supporters of the LCS program could argue that substantial data is available in the Navy’s annual budget submission on annual LCS research and development and procurement costs for the five-year period covered by the Future Years Defense Program (FYDP). Skeptics could argue that a major acquisition program like the LCS program should not proceed to higher annual rates of production until the program’s potential total acquisition cost is reported and assessed against other defense spending priorities.

Separate SAR Reporting of Sea Frame and Mission Module Costs

Another potential oversight issue for Congress is whether DOD should report LCS sea frame costs and LCS mission module costs in separate SARs, or together in the same SAR. As mentioned earlier (see “Estimated Acquisition Cost” in “Background”), DOD in its December 31, 2010, SAR for the LCS program stated that DOD has decided to “to separate the [LCS] program into two separate and distinct programs with separate reporting requirements. The Seaframe

³⁸ Government Accountability Office, *Defense Acquisitions[:] Assessments of Selected Weapon Programs*, GAO-11-233SP, March 2011, p. 100.

³⁹ Zachary M. Peterson, “DOD Report: LCS Program Faces ‘Medium Risk,’ Integration Challenges, *Inside the Navy*, April 26, 2010. Material in brackets as in original.

portion of the program is reported in this SAR as approved at MS [Milestone] B. The Mission Module portion of the program will begin reporting when it receives its Milestone B decision.”

Supporters of publishing these two sets of costs in separate SARs could argue that it will facilitate congressional oversight of the program by helping Congress differentiate sea frame costs from mission module costs. Supporters of publishing these two sets of costs together in the same SAR could argue that publishing them in separate SARs could complicate congressional oversight of the program by making the total cost of the LCS program as a whole (including costs for both sea frames and mission modules) less visible to Congress, and by making costs in the LCS sea frame SAR less easily comparable to costs reported in SARs for other Navy shipbuilding programs.

Operational Concepts

Another potential oversight issue for Congress for the LCS program concerns operational concepts for using LCSs once they enter service. A February 2010 GAO report stated:

The Navy has made progress in developing operational concepts for LCS, but faces risks in implementing its new concepts for personnel, training, and maintenance that are necessitated by the small crew size. Specifically, the Navy faces risks in its ability to identify and assign personnel given the time needed to achieve the extensive training required. GAO’s analysis of a sample of LCS positions showed an average of 484 days of training is required before reporting to a crew, significantly more than for comparable positions on other surface ships. Moreover, the Navy’s maintenance concept relies heavily on distance support, with little maintenance performed on ship. The Navy acknowledges that there are risks in implementing its new concepts and has established groups to address how to implement them. However, these groups have not performed a risk assessment as described in the 2008 National Defense Strategy. The Strategy describes the need to assess and mitigate risks to executing future missions and managing personnel, training, and maintenance. If the Navy cannot implement its concepts as envisioned, it may face operational limitations, have to reengineer its operational concepts, or have to alter the ship design. Many of the concepts will remain unproven until 2013 or later, when the Navy will have committed to building almost half the class. Having a thorough risk assessment of the new operational concepts would provide decision makers with information to link the effectiveness of these new concepts with decisions on program investment, including the pace of procurement.⁴⁰

An April 2011 news analysis article states:

The Navy promises this ship will be ideal for going after fast, swarming small craft like those operated by the Iranian Pasdaran, or Revolutionary Guards, and for chasing pirates. With speeds in excess of 40 knots, “it’s great for a knife fight,” some like to say. But the speed currently touted as a great war-fighting quality was originally meant for transit. You would perform your mine-hunting mission at the top of the Persian Gulf, for example, zip back to Bahrain or somewhere, change out the mission module in two or three hours, and zoom back to be on station by morning with a surface or anti-submarine warfare module installed, ready for action. But it gradually became apparent the modules couldn’t be swapped out that fast—two or three days is more like it—and the transit speed requirement diminished in value. Even though the original requirement is gone, the speed remains—at the

⁴⁰ Government Accountability Office, *Littoral Combat Ship[:] Actions Needed to Improve Operating Cost Estimates and Mitigate Risks in Implementing New Concepts*, GAO-10-257, February 2010, summary page.

cost of endurance and other factors—and the Navy has found other ways to describe its usefulness.

Another remarkable characteristic of the program is that the 20 ships just contracted or issued options for—on a fixed-price incentive basis—are the same basic designs already being built. Yet no true operational experience has been gained with the first ships, and the new ships show only a handful of modifications.

Apart from the Navy's inability to properly forecast how fast these ships could be built, fielded and paid for, there is a similar tone-deafness to how they will be employed. The service has done its best to estimate how the ships will be manned, supported, deployed and used, but at this point—eight years after the program started—it's still mostly conjecture.

It's one thing to develop a new class of destroyer or submarine or strike fighter. While new designs have updated and different features and capabilities, it is conceptually understood how to support and operate them. But that is not the case with the LCS. Just about everyone involved with the new type will have to learn how to support, operate and use them...

Although nearly half the planned LCS fleet is now built, under contract or with contract options, there is no demonstrable example of exactly how this LCS concept is going to work. Consider:

- LCS has no proven concept of operations. Tactical commanders with on-scene and area responsibilities so far have no experience in deploying these ships and experiencing what they can do.
- Command-and-control questions on the ships themselves remain. Who, for example, should have weapons release authority—the ship's commanding officer or the officer in charge of the mission detachment?
- Are the ships best operated in small numbers or in groups? What sorts of groups work best with each kind of mission? In what roles might they be effective on their own?
- What are the best mission sets for the ships? Already, Adm. John Harvey, head of U.S. Fleet Forces command, is urging the fleet not to use them in ways for which they are not intended—and that was after only one ship was in service. Do people understand what these ships are for and what they can do?
- The ships have no area air defense capability. Who will protect them and how will that be coordinated?
- No other surface ship has been designed to operate as many offboard vehicles as the LCS. How will each ship coordinate its own offboard systems, including unmanned air, surface and underwater vehicles? Should different ships take responsibility for particular dimensions—i.e., should one ship control all the underwater vehicles, or should that be left to each CO or OIC? Should one ship take on all those particular vehicles, or can each ship deploy its own?
- Are these ships well-suited to a “knife fight” with high-speed small craft, as some have urged, or would a better tactic be to stand off and fight with the 57mm gun and offboard systems such as armed helicopters or drones?
- Is the high speed really necessary? Should more fuel be added at the expense of speed?

- The ships are not patrol boats and do not have long endurance, despite proclamations that they are great for anti-piracy work. Do they need a redesign if that's the mission?
- Is it better to fit a ship with a single mission module for longer periods, or better to frequently swap out the modules?
- Can all the necessary personnel be accommodated? The ships are limited to 75 or 76 berths—no room for extra riders, such as special operations forces, or more likely, technical representatives for the multiplicity of vehicles each ship will eventually carry.
- Will the mission modules prove effective? The mine module already has lost several major components. Will it prove the equal of the fleet's mine countermeasures ships the LCS is set to replace? Will the anti-submarine warfare module really prove effective? Already, the Navy has classified the cost of the system, along with component details, so it has gotten harder to make this assessment. However, reports abound that the system is ineffective.
- Will the unique support systems for the ships prove their effectiveness? The tiny crew of 40 needs an exceptionally high level of pier support—will they get it? Will the needs of parts and maintenance supply be met routinely?
- Will future managers accept that both kinds of LCS have entirely separate and unique combat system suites? With dozens of different systems on each design, sailors qualified to serve on one LCS or the other are no more qualified to serve on the other LCS class than an amphibious sailor. Will that stand? At some point down the road, will some future CNO or Navy secretary decide that the fleet can't afford both types of combat systems and order the premature disposal of all of one of the types long before the end of their service life? Those are just some of the issues facing the development of the LCS.

Perhaps the only sure thing is that the Navy has tried its best to come up with possible answers to these questions. The thing to do now is not to promise that solutions are at hand but to put the LCS in the hands of young sailors and let them go out, get hands-on experience with the ships in multiple scenarios, find out how they'll work best, and adapt.

The 1930s were exciting times for sailors and aviators living through the great age of naval aviation experimentation and making believers out of doubters. The 2010s and 2020s could prove just as rewarding for today's LCS sailors, headed on courses both known and unknown.⁴¹

A report by the Center for Strategic and Budgetary Assessments (CSBA) provides additional discussion of possible operational concepts for the LCS.⁴²

⁴¹ Christopher P. Cavas, "Past Imperfect[:] Like First Carriers, Littoral Combat Ship Enters Age of Experimentation," *Armed Forces Journal*, April 2011 (accessed at <http://www.armedforcesjournal.com/2011/04/5848053>).

⁴² Martin M. Murphy, *Littoral Combat Ship[:] An Examination of its Possible Concepts of Operation*, Washington, Center for Strategic and Budgetary Assessments, 2010, 71 pp.

Legislative Activity for FY2012

FY2012 Funding Request

Under Navy budget plans, the four LCSs that the Navy wants to procure in FY2012 are to receive \$79.5 million in prior-year advance procurement (AP) funding. Navy's proposed FY2012 budget requests \$1,802.1 million in FY2012 procurement funding to complete the four ships' combined estimated procurement cost of \$1,881.6 million. The Navy's proposed FY2012 budget also requests \$79.6 million procurement funding for procurement of LCS mission packages, and \$286.8 million in research and development funding for the LCS program.

Appendix A. Legislative Activity for FY2011

Legislation to Provide Authority for Dual-Award Strategy

Continuing Appropriations and Surface Transportation Extensions Act, 2011 (H.R. 3082/P.L. 111-322)⁴³

Section 150 of H.R. 3082/P.L. 111-322 of December 22, 2010—an act that, among other things, funded federal government operations through March 4, 2011—provided the Navy authority to implement a dual-award strategy. The text of Section 150 is as follows:

SEC. 150. Subject to the availability of appropriations, the Secretary of the Navy may award a contract or contracts for up to 20 Littoral Combat Ships (LCS).

A Bill to Amend the FY2010 Defense Authorization Act (H.R. 6494)

H.R. 6494 would provide legislative authority for the Navy to implement a dual-award acquisition strategy for the LCS program. The bill was passed by the House on December 15, 2010. The text of H.R. 6494 is as follows:

SECTION 1. LITTORAL COMBAT SHIP PROGRAM.

(a) Contract Authority- Subsection (a) of section 121 of the National Defense Authorization Act for Fiscal Year 2010 (P.L. 111-84; 123 Stat. 2211) is amended—

(1) in paragraph (1)—

(A) by striking ‘ten Littoral Combat Ships and 15 Littoral Combat Ship ship control and weapon systems’ and inserting ‘20 Littoral Combat Ships, including any ship control and weapon systems the Secretary determines necessary for such ships,’; and

(B) by striking ‘a contract’ and inserting ‘one or more contracts’; and

(2) in paragraph (2), by striking ‘liability to’ and inserting ‘liability of’.

(b) Technical Data Package- Subsection (b)(2)(A) of such section is amended by striking ‘a second shipyard, as soon as practicable’ and inserting ‘another shipyard to build a design specification for that Littoral Combat Ship’.

(c) Limitation of Costs- Subsection (c)(1) of such section is amended by striking ‘awarded to a contractor selected as part of a procurement’ and inserting ‘under a contract’.

⁴³ H.R. 3082 was originally the FY2010 military construction, the Department of Veterans Affairs, and related agencies appropriations bill. H.R. 3082 became a continuing resolution that funded federal government operations through March 4, 2011 through the adoption in the Senate of S.Amdt. 4885, which was proposed on December 19, 2010.

Senate Amendment 4741 (S.Amdt. 4741) to FY2011 Defense Authorization Bill (S. 3454)

Senate Amendment (S.Amdt. 4741) to the FY2011 Defense Authorization Bill (S. 3454), submitted on December 8, 2010, would, among other things, provide legislative authority to the Navy to implement a dual-award acquisition strategy for the LCS program. The text of the first part of S.Amdt. 4741—the part relating to the LCS program—is as follows:

At the end of subtitle C of title I [of S. 3454], add the following:

SEC. 126. ADDITIONAL COMBAT SHIP MATTERS.

(a) Modifications to Littoral Combat Ship Program Authority.—Section 121 of the National Defense Authorization Act for Fiscal Year 2010 (P.L. 111-84; 123 Stat. 2211) is amended—

(1) in subsection (a)—

(A) in paragraph (1)—

(i) by striking “ten Littoral Combat Ships and 15 Littoral Combat Ship ship control and weapon systems” and inserting “20 Littoral Combat Ships (LCS), including ship control and weapon systems,”; and

(ii) by striking “a contract” and inserting “one or more contracts”; and

(B) in paragraph (2)—

(i) by striking “A contract” and inserting “Any contract”; and

(ii) by striking “liability to” and inserting “liability of”;

(2) in subsection (b)—

(A) in paragraph (1), by striking “a procurement” and inserting “any contract”; and

(B) in paragraph (2)—

(i) by striking “a Littoral” and inserting “any Littoral”; and

(ii) in subparagraph (A), by striking “a second shipyard, as soon as practicable” and inserting “another shipyard to build to a design specification for that Littoral Combat Ship”; and

(3) in subsection (c)(1), by striking “awarded to a contractor selected as part of a procurement” and inserting “under any contract”....

Legislation Relating to FY2011 Funding and Other Aspects of Program

FY2011 Funding Request

The Navy's proposed FY2011 budget requested \$1,231.0 million in procurement funding for the two LCSs that the Navy wants to procure in FY2011, and \$278.4 million in FY2011 advance procurement funding for 11 LCSs that the Navy wanted, under the FY2011 budget submission, to procure in FY2012-FY2014. (The Navy now wants, under the dual-award strategy, to procure 12 LCSs in FY2012-FY2014.) The Navy's proposed FY2011 budget also requested \$9.8 million in procurement funding to procure LCS module weapons, \$83.0 million in procurement funding for procurement of LCS mission packages, and \$226.3 million in research and development funding for the LCS program.

Summary of Congressional Action on FY2011 Funding Request

Table A-1 summarizes congressional action on the Navy's FY2011 funding request for the LCS program.

Table A-1. Congressional Action on FY2011 Funding Request

Millions of dollars, rounded to nearest tenth

	Request	Authorization			Appropriation		
		HASC	SASC	Conf.	HAC ^a	SAC	Final
Shipbuilding and Conversion, Navy (SCN) account, lines 12 and 13							
LCS sea frames	1,231.0	1,231.0	1,231.0	1,231.0	n/a ^a	615.5	1,169.0
(quantity)	(2)	(2)	(2)	(2)	n/a ^a	(1)	(2)
LCS sea frames (AP)	278.4	278.4	278.4	278.4	n/a ^a	278.4	190.4
Weapon Procurement, Navy (WPN account), line 30							
LCS module weapons	9.8	0.9	9.8	not clear	n/a ^a	0	0
Other Procurement, Navy (OPN) account, line 29							
LCS modules	83.0	83.0	83.0	not clear	n/a ^a	50.0	41.4
Research, Development, Test & Evaluation, Navy (RDT&EN) account, line 48							
LCS	226.3	305.5	226.3	not clear	n/a ^a	199.4	189.6

Sources: Table prepared by CRS based on Navy's FY2011 budget submission, committee reports, the text of S. 3454, the FY2011 defense authorization bill, as reported in the Senate, the joint explanatory statement of the House and Senate Armed Services Committees on H.R. 6523 (for authorization conference), and funding tables posted by the House Rules Committee for H.R. 1473 of the 112th Congress (for appropriation final). The joint explanatory statement for S. 3454 includes tables with recommended funding levels for full appropriation accounts, but not for line items within those accounts. The statement showed no recommended change to the requested total amount for the SCN account, but recommended changes to the requested total amounts for the WPN, OPN, and RDT&EN accounts.

Notes: **HASC** is House Armed Services Committee; **SASC** is Senate Armed Services Committee; **HAC** is House Appropriations Committee; **SAC** is Senate Appropriations Committee; **Conf.** is conference report; **Final** is final version of the appropriations bill (H.R. 1473 of the 112th Congress); **AP** is advance procurement for ships to be procured in future years.

- a. The full House Appropriations Committee did not file an official, numbered committee report for the FY2011 DOD appropriations act.

FY2011 DOD and Full-Year Continuing Appropriations Act (H.R. 1473/P.L. 112-10)

According to line-item funding tables posted by the House Rules Committee,⁴⁴ the FY2011 Department of Defense and Full-Year Continuing Appropriations Act (H.R. 1473/P.L. 112-10 of April 15, 2011):

- reduces the Navy's FY2011 procurement funding request in the SCN account for LCS sea frames by \$62.0 million, with the reduction being for "Cost Savings";
- reduces the Navy's FY2011 advance procurement (AP) funding request in the SCN account for LCS sea frames by \$88.0 million, with the reduction being for "Program Reduction";
- rejects the Navy's FY2011 procurement funding request in the WPN account for LCS module weapons, with the reduction to zero being for "NLOS Program Termination";
- reduces the Navy's FY2011 procurement funding request in the OPN account for LCS modules by \$41.582 million, including \$6.0 million for "MCM Module Production Support Growth," \$3.064 million for "Consulting Services Growth," \$7.6 million for "Excess Remote Multi-Mission Vehicle Funding," \$2.268 million for "Mission Package Computer Environment Units Ahead of Need," and \$22.65 million for "AN/AQS-20A – Ahead of Need"; and
- reduces the Navy's FY2011 research and development funding request in the RDT&EN account for the LCS program by a net total of \$36.7 million, including
 - reductions of \$15.8 million for "LCS-2 post shakedown availability delay," \$0.5 million for "LCS-1 post shakedown availability planning funding excess," \$15.4 million for "NLOS missile termination," \$2.0 million for "Navy requested transfer to [RDT&EN account] line 49 ["Combat System Integration"] for Automatic Test and Re-Test," and \$15 million for "Savings from accelerated DT," and
 - increases of \$4.0 million for "Program Increase – Mine Warfare Testing Disruption" and \$8.0 million for "Program Increase – Small Business Technology Insertion (Mine Warfare Modules).

FY2011 DOD Appropriations Bill (S. 3800)

Senate

The Senate Appropriations Committee, in its report (S.Rept. 111-295 of September 16, 2010) on S. 3800 of the 111th Congress, recommends \$615.5 million in procurement funding for the procurement in FY2011 of one LCS sea frame—a reduction of \$615.5 million and one LCS sea frame from the Navy's request (page 86, line 12). The committee's report states:

⁴⁴ The funding tables were posted at <http://rules.house.gov/Legislation/legislationDetails.aspx?NewsID=244>.

Littoral Combat Ship [LCS].—The fiscal year 2011 budget request included \$1,230,984,000 for the construction of two LCS ships and \$278,351,000 in advance procurement funding for future ships. The Committee supports the revised acquisition strategy for the LCS program and the decision to down-select to one variant in fiscal year 2010. The Committee, however, is concerned with the very aggressive construction schedule proposed in the budget request. Based on the historical poor cost and schedule performance of the program, including the current delay in the down-select decision, the Committee is concerned that the proposed ramp up to construct four ships in fiscal year 2011 is too aggressive and may be unexecutable. Therefore, the Committee recommends re-phasing the LCS construction schedule by reducing the budget request by \$615,492,000 and one ship in fiscal year 2011. The Committee directs the Navy to add one LCS back into the program during the Future Years Defense Plan. (Page 87)

The committee's report also states:

The Secretary of Defense should be applauded for trying to gain greater control over runaway costs, schedule delays, and requirements creep. However, the Committee remains frustrated by the lack of proper control in the Defense budget process as exemplified by the examples listed below. The Navy should be commended for reshaping its Littoral Combat Ship program to down select to one contractor with the goal of reducing costs. However, the ensuing delay in this program has led to a schedule in which the winning contractor will not be able to begin constructing the second of two LCS ships requested in fiscal year 2011. Nonetheless, neither the Navy nor the Defense Department has suggested reducing the budget request even though more than \$600,000,000 will not be required this fiscal year. (Page 7)

The committee's report recommends approving the Navy's request for \$278.4 million in advance procurement funding for LCSs to be procured in future years (page 86, line 13).

The committee's report recommends denying the Navy's request for \$9.8 million in procurement funding for the procurement of LCS weapon modules due to the termination of the NLOS-LS program (page 82, line 30).

The committee's report recommends reducing by \$32.9 million the Navy's request for procurement funding for the procurement of LCS modules due to unjustified growth in production engineering (\$6 million reduction), mission package computer environment units requested ahead of need (\$2.3 million reduction), unjustified growth in consulting services (\$2 million reduction), and AN/AQS-20A minehunting sonar equipment requested ahead of need (\$22.7 million reduction) (page 95, line 29).

The committee's report recommends reducing the Navy's request for research and development funding for the LCS program by a net total of \$26.9 million, including a reduction of \$15.4 million due to the termination of the NLOS-LS program, a reduction of \$15.0 million due to savings from "accelerated DT" (which might be a reference to accelerated developmental testing), and an increase of \$3.5 million for LCS axial flow high power density waterjets (page 150, line 48).

FY2011 Defense Authorization Act (H.R. 6523/P.L. 111-383)***House (H.R. 5136)***

The House Armed Services Committee, in its report (H.Rept. 111-491 of May 21, 2010) on the FY2011 defense authorization bill (H.R. 5136), recommends approval of the Navy's FY2011 procurement and advance procurement funding requests for LCS sea frames (page 73) and LCS modules (page 81, line 029). The report recommends reducing by \$8.9 million the Navy's FY2011 procurement funding request for LCS module weapons due to termination of the NLOS-LS program (page 68, line 030). The report recommends increasing the Navy's FY2011 request for LCS research and development funding by \$75.0 million for Navy NLOS-NS development, and by \$4.25 million for axial-flow high-power-density waterjets (page 148).

The report states:

Littoral Combat Ship

The Littoral Combat Ship program has failed its initial intent to build inexpensive ships with modular capability and field them to the fleet at a high rate. None of those goals have been met. The ships are expensive; the modular capability has not been tested or verified; and in some cases is still undergoing development; and only two of the ships have been delivered to the Navy.

Last year, the committee supported the request of the Secretary of the Navy and the Chief of Naval Operations to revamp the acquisition strategy for these vessels and to down-select to one variant of the ship with the award of the fiscal year 2010 two-ship authorization. The new acquisition strategy is aimed at reducing overall costs by procuring 10 ships in the Future Years Defense Plan using a fixed price incentive contract in fiscal year 2010 with priced options for 8 additional ships, 2 per year, in fiscal years 2011–15. In addition, the government would gain all rights to the technical data package required to compete the winning design to a second source shipyard which would build 5 additional ships, for a total of 15 ships, between fiscal years 2012 and 2015. The committee supported this plan as the best alternative to provide needed capability to the fleet in the shortest time possible, at the least cost. The plan was also proposed to the committee as the best way to divorce the prime contractors from the program and to transition the ship's installed combat systems to government furnished equipment that complimented equipment currently in use in the fleet.

As of this report, the Navy has received the proposals from the two authorized competitors and is in the process of source selection leading to contract award. The committee is cautiously optimistic that, with a down-select to one variant and stability in the construction schedule, this troubled program can begin to fulfill its original purpose of providing capable ships, in quantity, at an affordable cost. (Pages 76-77)

The report also states:

Littoral Combat Ship Module weapons

The budget request contained \$9.8 million for Littoral Combat Ship (LCS) Module Weapons, of which \$8.9 million was requested for procurement of 45 non-line-of-sight launch system (NLOS-LS) missiles.

The committee notes that the Army has terminated the NLOS-LS program, and even if it is continued by the Navy, an additional year of development work will be required. As a result,

the committee does not agree with Navy procurement funding for NLOS-LS in fiscal year 2011. In title II of this report, the committee recommends an increase in Navy research and development funding to support continued development work for the NLOS-LS program if the Navy determines that is in the best interest of the LCS program.

The committee recommends \$0.9 million, a decrease of \$8.9 million, for LCS Module weapons. (Page 69)

The report also states:

Navy non-line-of-sight launch system development

The budget request contained \$226.3 million in PE 63581N⁴⁵ for Littoral Combat Ship mission module research and development but contained no funds for the non-line-of-sight launch system (NLOS-LS).

The committee notes that the Army's termination of the NLOS-LS could leave the Navy's Littoral Combat Ship (LCS) without sufficient capability to defeat small boat threats and unable to provide precision fire support to Marine Corps forces. The committee is informed that the NLOS-LS will likely require only one more year of research and development work to achieve threshold requirements. Therefore, in order to take advantage of the \$1.5 billion in development funds spent to date, the committee encourages the Navy to complete development of the NLOS-LS system for use on the LCS. The committee also directs the Assistant Secretary of the Navy for Research, Development, and Acquisition to provide a report to the congressional defense committees by December 15, 2010, on the feasibility and utility of the Navy completing development of the NLOS-LS. The report should include an analysis of possible unit cost reduction options.

The committee recommends \$301.3 million, an increase of \$75.0 million, in PE 63581N for research and development of the NLOS-LS for use on the LCS. (Pages 159-160)

Senate (S. 3454)

The FY2011 defense authorization bill (S. 3454), as reported by the Senate Armed Services Committee (S.Rept. 111-201 of June 4, 2010), recommends approval of the Navy's requests for FY2011 procurement and advance procurement funding for LCS sea frames (see page 677, lines 12 and 13, of the printed bill), LCS module weapons (page 675, line 30), LCS modules (page 680, line 29), and LCS research and development (page 732, line 48). The committee's report states:

The Littoral Combat Ship (LCS) program has made progress during the past year and the recent decision to move to a single design should improve affordability. The LCS fleet is expected to comprise 55 vessels of the Navy's 313-ship fleet force structure. Even modest cost growth in this large component of the fleet magnifies the problem of achieving that objective. The committee notes that the Navy's acquisition strategy for the LCS program introduces competition for this class of ships and is therefore cautiously optimistic that this program is making progress. (Page 41)

The committee's report also states:

⁴⁵ Line items in DOD research and development accounts are called program elements (PEs).

Littoral combat ship report

The committee has concluded that the projected ship decommissioning and construction schedule presented in the Navy's program described in its "Report to Congress on Annual Long-Range Plan for Construction of Naval Vessels for FY 2011" could have a negative effect on some of the Nation's Navy bases. This would arise because of a gap that will occur as a result of small surface combatants being retired years before Littoral Combat Ship replacements will arrive.

The Navy's 2010 document "Report on Strategic Plan for Homeporting the Littoral Combat Ship" provided the committee with the Navy's notional strategic plan for stationing the Littoral Combat Ship through fiscal year 2020. In order to fully understand the effects of the Navy's current decommissioning and shipbuilding timeline, the committee directs the Secretary of the Navy to submit a report to the congressional defense committees that would provide the timeline and detailed homeport locations for the Littoral Combat Ships that will be delivered through 2020. The committee directs the Secretary of the Navy to submit the reports at the time the President submits his fiscal year 2012 budget proposal to Congress.

As the Navy finalizes its plans, the committee encourages the Navy to expedite delivery of the Littoral Combat Ship to those Navy bases that need replacement ships to mitigate capability gaps that will result from the retirement of smaller surface combatants. (Page 116)

Final Version (H.R. 6523/P.L. 111-383)

H.R. 6523/P.L. 111-383 of January 7, 2011, does not appear to include any provisions relating specifically to the LCS program. The joint explanatory statement of the House and Senate Armed Services Committees on H.R. 6523 does not discuss the program.

Appendix B. Summary of Congressional Action in FY2005-FY2011

This appendix presents a summary of congressional action on the LCS program in FY2005-FY2010.

FY2005

In FY2005, Congress approved the Navy's plan to fund the construction of the first two LCS sea frames using research and development funds rather than shipbuilding funds, funded the first construction cost of the first LCS (LCS-1), required the second LCS (LCS-2) to be built (when funded in FY2006) to a different design from the first, prohibited the Navy from requesting funds in FY2006 to build a third LCS, and required all LCSs built after the lead ships of each design to be funded in the SCN account rather than the Navy's research and development account.

FY2006

In FY2006, Congress funded the procurement of LCSs 2, 3, and 4. (The Navy requested one LCS for FY2006, consistent with Congress's FY2005 action. Congress funded that ship and provided funding for two additional ships.) Congress in FY2006 also established a unit procurement cost limit on the fifth and sixth LCS sea frames of \$220 million per ship, plus adjustments for inflation and other factors (Section 124 of the FY2006 defense authorization bill [H.R. 1815/P.L. 109-163] of January 6, 2006), required an annual report on LCS mission packages and made procurement of more than four LCSs contingent on the Navy certifying that there exists a stable design for the LCS.

FY2007

In FY2007, Congress funded the procurement of LCSs 5 and 6. (The Navy canceled these two ships in 2007 before they were placed under contract for construction.)

FY2008

In FY2008, Congress accepted the Navy's cancellation of LCSs 3 through 6; funded the procurement one additional LCS in FY2008 (which the Navy called LCS-5);⁴⁶ significantly reduced the Navy's FY2008 funding request for the LCS program; amended the LCS sea frame unit procurement cost cap to \$460 million per ship for LCSs procured in FY2008 and subsequent years (Section 125 of the conference report [H.Rept. 110-477 of December 6, 2007] on H.R. 1585, the FY2008 defense authorization bill, which was enacted as H.R. 4986/P.L. 110-181 of

⁴⁶ The Navy apparently called this ship LCS-5 because the original LCS-5 and LCS-6 were canceled by the Navy before they were replaced under contract, leaving LCS-4 as last LCS under contract to have been canceled. In spite of its designation, LCS-5 would have been the third LCS in the restructured LCS program, and was the seventh to have been funded by Congress.

January 28, 2008); and required the Navy to use fixed-price-type contracts for the construction of LCSs procured in FY2008 and subsequent years.

The Navy in 2007 requested that Congress amend the existing unit procurement cost cap for the fifth and sixth ships to \$460 million, plus adjustments for inflation and other factors. Congress amended the cost cap to \$460 million, but applied it not only to the fifth and sixth LCSs, but to all LCSs procured in FY2008 and subsequent years. The use of fixed-price contracts for future LCSs was something that the Navy had stated an intention to do as part of its plan for restructuring the LCS program.

FY2009

In FY2009, Congress delayed the implementation of the LCS sea frame unit procurement cost cap by two years, to ships procured in FY2010 and subsequent years (Section 122 of the FY2009 defense authorization act [S. 3001/P.L. 110-417 of October 14, 2008]); rescinded \$337 million in FY2008 shipbuilding funds for the LCS program, effectively canceling the funding for the LCS procured in FY2008 (Section 8042 of the FY2009 defense appropriations act [Division C of H.R. 2638/P.L. 110-329 of September 30, 2008]); and funded the procurement of two LCSs at a cost of \$1,020 million.

FY2010

In FY2010 Congress funded the procurement of two LCSs at a cost of \$1,080 million and rescinded \$66 million in FY2009 Other Procurement, Navy (OPN) funding for LCS mission modules. Section 121 of the FY2010 defense authorization act (H.R. 2647/P.L. 111-84 of October 28, 2009) granted the Navy contracting and other authority to implement the LCS acquisition strategy that the Navy announced on September 16, 2009, and amended the LCS unit procurement cost cap. Section 122 of the act requires the LCS program to be treated as a major defense acquisition program (MDAP) for purposes of program management and oversight. Section 123 of the act required a report on the Navy's plan for homeporting LCSs.

FY2011

In FY2011, approved the Navy's request for authority to implement a dual-award acquisition strategy for the LCS program through Section 150 of H.R. 3082/P.L. 111-322, and funded the procurement of two LCSs at a cost of \$1,169.0 million in H.R. 1473/P.L. 112-10.

Appendix C. Cost Growth on LCS Sea Frames in FY2007-FY2012 Budgets

This appendix presents details on cost growth on the first few LCS sea frames in the FY2007-FY2012 budget submissions.

FY2007 Budget

The proposed FY2007 Navy budget, submitted in February 2006, showed that:

- the estimate for the first LCS had increased from \$215.5 million in the FY2005 budget and \$212.5 million in the FY2006 budget to \$274.5 million in the FY2007 budget—an increase of about 27% from the FY2005 figure and about 29% from the FY2006 figure;
- the estimate for the second LCS increased from \$213.7 million in the FY2005 budget and \$256.5 million in the FY2006 budget to \$278.1 million—an increase of about 30% from the FY2005 figure and about 8% from the FY2006 figure; and
- the estimate for follow-on ships scheduled for FY2009-FY2011, when the LCS program was to have reached a planned maximum annual procurement rate of six ships per year, had increased from \$223.3 million in the FY2006 budget to \$298 million—an increase of about 33%.

The Navy stated in early 2006 that the cost increase from the FY2006 budget to the FY2007 budget was due mostly to the fact that LCS procurement costs in the FY2006 budget did not include items that are traditionally included in the so-called end cost—the total budgeted procurement cost—of a Navy shipbuilding program, such as Navy program-management costs, an allowance for changes, and escalation (inflation). The absence of these costs from the FY2006 LCS budget submission raised certain potential oversight issues for Congress.⁴⁷

⁴⁷ These oversight issues included the following:

—Why were these costs excluded? Was this a budget-preparation oversight? If so, how could such an oversight occur, given the many people involved in Navy budget preparation and review, and why did it occur on the LCS program but not other programs? Was anyone held accountable for this oversight, and if so, how? If this was not an oversight, then what was the reason?

—Did the Navy believe there was no substantial risk of penalty for submitting to Congress a budget presentation for a shipbuilding program that, for whatever reason, significantly underestimated procurement costs?

—Do LCS procurement costs in the budget now include all costs that, under traditional budgeting practices, should be included? If not, what other costs are still unacknowledged?

—Have personnel or other resources from other Navy programs been used for the LCS program in any way? If so, have the costs of these personnel or other resources been fully charged to the LCS program and fully reflected in LCS program costs shown in the budget?

FY2008 Budget

On January 11, 2007, the Navy reported that LCS-1 was experiencing “considerable cost overruns.” The Navy subsequently stated that the estimated shipyard construction cost of LCS-1 had grown to \$350 million to \$375 million. This suggested that the end cost of LCS-1—which also includes costs for things such as Navy program-management costs and an allowance for changes—could be in excess of \$400 million. The Navy did not publicly provide a precise cost overrun figure for LCS 2, but it stated that the cost overrun on LCSs 1 and 2 was somewhere between 50% and 75%, depending on the baseline that is used to measure the overrun.

GAO testified in July 2007 that according to its own analysis of Navy data, the combined cost of LCSs 1 and 2 had increased from \$472 million to \$1,075 million—an increase of 128%.⁴⁸ CBO testified in July 2007 that:

Several months ago, press reports indicated that the cost could well exceed \$400 million each for the first two LCS sea frames. Recently, the Navy requested that the cost cap for the fifth and sixth sea frames be raised to \$460 million, which suggests that the Navy’s estimate of the acquisition cost for the first two LCSs would be around \$600 million apiece....

As of this writing, the Navy has not publicly released an estimate for the LCS program that incorporates the most recent cost growth, other than its request to raise the cost caps for the fifth and sixth ships. CBO estimates that with that growth included, the first two LCSs would cost about \$630 million each, excluding mission modules but including outfitting, postdelivery, and various nonrecurring costs associated with the first ships of the class. As the program advances, with a settled design and higher annual rates of production, the average cost per ship is likely to decline. Excluding mission modules, the 55 LCSs in the Navy’s plan would cost an average of \$450 million each, CBO estimates.⁴⁹

FY2009 Budget

The proposed FY2009 budget, submitted in February 2008, showed that the estimated end costs of LCS-1 and LCS-2 had increased to \$531 million and \$507 million, respectively (or to \$631 million and \$636 million, respectively, when OF/DP and FST MSSIT costs are included, or to \$606 million and \$582 million, respectively, when OF/DP costs are included, but FST MSSIT costs are not included).

FY2010 Budget

The proposed FY2010 budget, submitted in May 2009, showed that the estimated end costs of LCS-1 and LCS-2 had increased to \$537 million and \$575 million, respectively (or to \$637 million and \$704 million, respectively, when OF/DP and FST MSSIT costs are included, or to

⁴⁸ Defense Acquisitions[:] Realistic Business Cases Needed to Execute Navy Shipbuilding Programs, Statement of Paul L. Francis, Director, Acquisition and Sourcing Management Team, Testimony Before the Subcommittee on Seapower and Expeditionary Forces, Committee on Armed Services, House of Representatives, July 24, 2007 (GAO-07-943T), pp. 4 and 22.

⁴⁹ Statement of J. Michael Gilmore, Assistant Director for National Security, and Eric J. Labs, Senior Analyst, [on] The Navy’s 2008 Shipbuilding Plan and Key Ship Programs, before the Subcommittee on Seapower and Expeditionary Forces Committee on Armed Services U.S. House of Representatives, July 24, 2007, p. 18.

\$612 million and \$650 million, respectively, when OF/DP costs are included, but FST MSSIT costs are not included). CBO reported on June 9, 2008, that:

Historical experience indicates that cost growth in the LCS program is likely. In particular, using the lead ship of the FFG-7 Oliver Hazard Perry class frigate as an analogy, historical cost-to-weight relationships indicate that the Navy's original cost target for the LCS of \$260 million in 2009 dollars (or \$220 million in 2005 dollars) was optimistic. The first FFG-7 cost about \$670 million in 2009 dollars to build, or about \$250 million per thousand tons, including combat systems. Applying that metric to the LCS program suggests that the lead ships would cost about \$600 million apiece, including the cost of one mission module. Thus, in this case, the use of a historical cost-to-weight relationship produces an estimate that is less than the actual costs of the first LCSs to date but substantially more than the Navy's original estimate.

Based on actual costs the Navy has incurred for the LCS program, CBO estimates that the first two LCSs could cost about \$700 million each, including outfitting and postdelivery and various nonrecurring costs associated with first ships of a class but excluding mission modules. However, as of May 1, 2008, LCS-1 was 83 percent complete and LCS-2 was 68 percent complete. Thus, additional cost growth is possible, and CBO's estimate reflects that cost risk.

Overall, CBO estimates that the LCSs in the Navy's plan would cost about \$550 million each, on average, excluding mission modules. That estimate assumes that the Navy would select one of the two existing designs and make no changes. As the program advanced with a settled design and higher annual rates of production, average ship costs would probably decline. If the Navy decided to make changes to that design, however, the costs of building future ships could be higher than CBO now estimates.⁵⁰

FY2011 Budget

The proposed FY2011 budget, submitted in February 2010, showed that the estimated end cost of LCS-1 remained unchanged from the previous year at \$537 million, and that the estimated end cost of LCS-2 had increased to \$607 million. These two figures become \$656 million and \$736 million, respectively, when OF/DP and FST MSSIT costs are included, or \$631 million and \$682 million, respectively, when OF/DP costs are included, but FST MSSIT costs are not included. The Navy's FY2011 budget submission states that OF/DP and FST MSSIT costs are non-end cost items, and that FSD MSSIT costs for LCS-1 and LCS-2 "are not true construction costs and are [instead] costs associated with design completion."⁵¹

FY2012 Budget

The proposed FY2012 budget, submitted in February 2011, showed that the estimated end cost of LCS-1 remained unchanged from the previous year at \$537 million, and that the estimated end cost of LCS-2 had increased to \$653 million. These two figures become \$670.4 million and

⁵⁰ Congressional Budget Office, *Resource Implications of the Navy's Fiscal Year 2009 Shipbuilding Plan*, June 8, 2008, pp. 26-27.

⁵¹ Source: Department of Navy, *Department of the Navy Fiscal Year (FY) 2011 Budget Estimates, February 2010, Justification of Estimates, Research, Development, Test & Evaluation, Navy, Budget Activity 4*, Exhibit R-2A, RDT&E Project Justification, PE 0603581N: Littoral Combat Ship (LCS), pages 34-35 of 46 (pdf pages 552-553 of 1054).

\$808.8 million, respectively, when OF/DP and FST MSSIT costs are included, or \$645.4 million and \$754.8 million, respectively, when OF/DP costs are included, but FST MSSIT costs are not included. The Navy's FY2011 budget submission states that OF/DP and FST MSSIT costs are non-end cost items, and that FSD MSSIT costs for LCS-1 and LCS-2 "are not true construction costs and are [instead] costs associated with design completion."⁵²

Reasons for Cost Growth

Various reasons have been cited for cost growth in the LCS program, including the following:

- **Unrealistically low original estimate.** Some observers believe that the original cost estimate of \$220 million for the LCS sea frame was unrealistically low. If so, a potential follow-on question would be whether the LCS represents a case of "low-balling"—using an unrealistically low cost estimate in the early stages of a proposed weapon program to help the program win approval and become an established procurement effort.
- **Impact of Naval Vessel Rules (NVR).** Navy and industry officials have attributed some of the cost growth to the impact of applying new Naval Vessel Rules (NVR)—essentially, new rules specifying the construction standards for the ship—to the LCS program. The NVR issued for the LCS program incorporated, among other things, an increase in the survivability standard (the ability to withstand damage) to which LCSs were to be built. Building the ship to a higher survivability standard represented a change in requirements for the ship that led to many design changes, including changes that made ship more rugged and more complex in terms of its damage-control systems. In addition, Navy and industry officials have testified, the timing of the issuing of NVR created a situation of concurrency between design and construction in the LCS program, meaning that the ship was being designed at the same time that the shipyard was attempting to build it—a situation long known to be a potential cause of cost growth. This concurrency, Navy officials testified, was a consequence of the compressed construction schedule for the LCS program, which in turn reflected an urgency about getting LCSs into the fleet to meet critical mission demands.
- **Improperly manufactured reduction gear.** Navy and industry officials testified that cost growth on LCS-1 was partly due to a main reduction gear⁵³ that was incorrectly manufactured and had to be replaced, forcing a reordering of the construction sequence for the various major sections of the ship.
- **Increased costs for materials.** Some observers have attributed part of the cost growth in the program to higher-than-estimated costs for steel and other materials that are used in building the ships.
- **Emphasis on meeting schedule combined with cost-plus contract.** Some portion of cost growth on LCS-1 has been attributed to a combination of a Navy

⁵² Source: Department of Defense, *Department of Defense Fiscal Year (FY) 2012 Budget Estimates, February 2011, Navy Justification Book Volume 2, Research, Development, Test & Evaluation, Navy, Budget Activity 4, Exhibit R-2A, RDT&E Project Justification, PE 0603581N: Littoral Combat Ship (LCS)*, page 33 of 42 (pdf page 469 of 888).

⁵³ A ship's reduction gear is a large, heavy gear that reduces the high-speed revolutions of the ship's turbine engines to the lower-speed revolutions of its propellers.

emphasis on meeting the ship's aggressive construction schedule and the Navy's use of a cost-plus contract to build the ship.⁵⁴

- **Shipyard Performance.** Shipyard performance and supervision of the LCS shipyards by the LCS team leaders and the Navy has been cited as another cause of cost growth.⁵⁵

July 2007 GAO Testimony

GAO testified in July 2007 that:

We have frequently reported on the wisdom of using a solid, executable business case before committing resources to a new product development effort....

A sound business case would establish and resource a knowledge-based approach at the outset of a program. We would define such a business case as firm requirements, mature technologies, and an acquisition strategy that provides sufficient time and money for design activities before construction start. The business case is the essential first step in any acquisition program that sets the stage for the remaining stages of a program, namely the business or contracting arrangements and actual execution or performance. If the business case is not sound, the contract will not correct the problem and execution will be subpar. This does not mean that all potential problems can be eliminated and perfection achieved, but rather that sound business cases can get the Navy better shipbuilding outcomes and better return on investment. If any one element of the business case is weak, problems can be expected in construction. The need to meet schedule is one of the main reasons why programs cannot execute their business cases. This pattern was clearly evident in both the LPD 17 [amphibious ship] and LCS programs. In both cases, the program pushed ahead with production even when design problems arose or key equipment was not available when needed. Short cuts, such as doing technology development concurrently with design and construction, are taken to meet schedule. In the end, problems occur that cannot be resolved within compressed, optimistic schedules. Ultimately, when a schedule is set that cannot accommodate program scope, delivering an initial capability is delayed and higher costs are incurred....

What happens when the elements of a solid business case are not present? Unfortunately, the results have been all too visible in the LPD 17 and the LCS. Ship construction in these programs has been hampered throughout by design instability and program management

⁵⁴ The Senate Armed Services Committee, as part of its discussion of the LCS program in its report (S.Rept. 110-77 of June 5, 2007) on the FY2008 defense authorization bill (S. 1547), stated:

Reviewing this LCS situation will undoubtedly result in a new set of "lessons learned" that the acquisition community will dutifully try to implement. However, the committee has previously expressed concerns about the LCS concept and the LCS acquisition strategy. The LCS situation may be more a case of "lessons lost." Long ago, we knew that we should not rush to sign a construction contract before we have solidified requirements. We also knew that the contractors will respond to incentives, and that if the incentives are focused on maintaining schedules and not on controlling cost, cost growth on a cost-plus contract should surprise no one. After the fact, everyone appears ready to agree that the original ship construction schedule for the lead ship was overly aggressive. (Page 98)

⁵⁵ See Katherine McIntire Peters, "Navy's Top Officer Sees Lessons In Shipbuilding Program Failures," *GovernmentExecutive.com*, September 24, 2008; Christopher J. Castelli, "Audit Exposes Failed Management of Troubled Littoral Warship," *Inside the Navy*, February 4, 2008; Christopher J. Castelli, "Audit Reveals Both LCS and Industry Teams Violated Management Rules," *Inside the Pentagon*, July 10, 2008 (reprinted in essentially identical form, with the same headline, in the July 14, 2008, issue of sister publication *Inside the Navy*).

challenges that can be traced back to flawed business cases. The Navy moved forward with ambitious schedules for constructing LPD 17 and LCS despite significant challenges in stabilizing the designs for these ships. As a result, construction work has been performed out of sequence and significant rework has been required, disrupting the optimal construction sequence and application of lessons learned for follow-on vessels in these programs....

In the LCS program, design instability resulted from a flawed business case as well as changes to Navy requirements. From the outset, the Navy sought to concurrently design and construct two lead ships in the LCS program in an effort to rapidly meet pressing needs in the mine countermeasures, antisubmarine warfare, and surface warfare mission areas. The Navy believed it could manage this approach, even with little margin for error, because it considered each LCS to be an adaptation of an existing high-speed ferry design. It has since been realized that transforming a high-speed ferry into a capable, networked, survivable warship was quite a complex venture. Implementation of new Naval Vessel Rules (design guidelines) further complicated the Navy's concurrent design-build strategy for LCS. These rules required program officials to redesign major elements of each LCS design to meet enhanced survivability requirements, even after construction had begun on the first ship. While these requirements changes improved the robustness of LCS designs, they contributed to out of sequence work and rework on the lead ships. The Navy failed to fully account for these changes when establishing its \$220 million cost target and 2-year construction cycle for the lead ships.

Complicating LCS construction was a compressed and aggressive schedule. When design standards were clarified with the issuance of Naval Vessel Rules and major equipment deliveries were delayed (e.g., main reduction gears), adjustments to the schedule were not made. Instead, with the first LCS, the Navy and shipbuilder continued to focus on achieving the planned schedule, accepting the higher costs associated with out of sequence work and rework. This approach enabled the Navy to achieve its planned launch date for the first Littoral Combat Ship, but required it to sacrifice its desired level of outfitting. Program officials report that schedule pressures also drove low outfitting levels on the second Littoral Combat Ship design as well, although rework requirements have been less intensive to date. However, because remaining work on the first two ships will now have to be completed out-of-sequence, the initial schedule gains most likely will be offset by increased labor hours to finish these ships.

The difficulties and costs discussed above relate to the LCS seaframe only. This program is unique in that the ship's mission equipment is being developed and funded separately from the seaframe. The Navy faces additional challenges integrating mission packages with the ships, which could further increase costs and delay delivery of new antisubmarine warfare, mine countermeasures, and surface warfare capabilities to the fleet. These mission packages are required to meet a weight requirement of 180 metric tons or less and require 35 personnel or less to operate them. However, the Navy estimates that the mine countermeasures mission package may require an additional 13 metric tons of weight and seven more operator personnel in order to deploy the full level of promised capability. Because neither of the competing ship designs can accommodate these increases, the Navy may be forced to reevaluate its planned capabilities for LCS.⁵⁶

⁵⁶ Defense Acquisitions[:] Realistic Business Cases Needed to Execute Navy Shipbuilding Programs, Statement of Paul L. Francis, Director, Acquisition and Sourcing Management Team, Testimony Before the Subcommittee on Seapower and Expeditionary Forces, Committee on Armed Services, House of Representatives, July 24, 2007 (GAO-07-943T), pp. 8-11.

Appendix D. 2007 Program Restructuring and Ship Cancellations

The Navy substantially restructured the LCS program in 2007 in response to significant cost growth and delays in constructing the first LCS sea frames. This restructuring led to the cancellation of four LCSs that were funded in FY2006 and FY2007. A fifth LCS, funded in FY2008, was cancelled in 2008. This appendix presents the details of the program restructuring and ship cancellations.

2007 Program Restructuring

March 2007 Navy Restructuring Plan

In response to significant cost growth and schedule delays in the building of the first LCSs that first came to light in January 2007 (see next section), the Navy in March 2007 announced a plan for restructuring the LCS program that:

- canceled the two LCSs funded in FY2007 and redirected the funding for those two ships to pay for cost overruns on earlier LCSs;
- announced an intention to lift a 90-day stop-work order that the Navy had placed on LCS-3 in January 2007—provided that the Navy reached an agreement with the Lockheed-led industry team by April 12, 2007, to restructure the contract for building LCSs 1 and 3 from a cost-plus type contract into a fixed price incentive (FPI)-type contract—or terminate construction of LCS-3 if an agreement on a restructured contract could not be reached with the Lockheed team by April 12, 2007;
- announced an intention to seek to restructure the contract with the General Dynamics-led industry team for building LCSs 2 and 4 into an FPI-type contract—if LCSs 2 and 4 experienced cost growth comparable to that of LCSs 1 and 3—and, if such a restructuring were sought, terminate construction of LCS-4 if an agreement on a restructured contract for LCS-2 and LCS-4 could not be reached;
- reduced the number of LCSs requested for FY2008 from three to two (for the same requested FY2008 procurement funding of \$910.5 million), and the number to be requested for FY2009 from six to three; and
- announced an intention to conduct an operational evaluation to select a favored design for the LCS that would be procured in FY2010 and subsequent years, and to conduct a full and open follow-on competition among bidders for the right to build that design.⁵⁷

⁵⁷ Source: Navy briefing to CRS and Congressional Budget Office (CBO) on Navy's proposed LCS program restructuring plan, March 21, 2007.

April 2007 Termination of LCS-3

On April 12, 2007, the Navy announced that it had not reached an agreement with Lockheed on a restructured FPI-type contract for LCS-1 and LCS-3, and consequently was terminating construction of LCS-3.⁵⁸ (The Navy subsequently began referring to the ship as having been partially terminated—a reference to the fact that Lockheed was allowed to continue procuring certain components for LCS-3, so that a complete set of these components would be on hand to be incorporated into the next LCS built to the Lockheed design.) (The designation LCS-3 is now being reused to refer to one of the two LCSs procured in FY2009.)

November 2007 Termination of LCS-4

In late September 2007, it was reported that the Navy on September 19 had sent a letter to General Dynamics to initiate negotiations on restructuring the contract for building LCSs 2 and 4 into an FPI-type contract. The negotiations reportedly were to be completed by October 19, 2007—30 days from September 19.⁵⁹ On November 1, 2007, the Navy announced that it had not reached an agreement with General Dynamics on a restructured FPI-type contract for LCS-2 and LCS-4, and consequently was terminating construction of LCS-4.⁶⁰ (The designation LCS-4 is now being reused to refer to one of the two LCSs procured in FY2009.)

Cancellation of Prior-Year Ships

Table D-1 below summarizes the status of the nine LCSs funded by Congress from FY2005 through FY2009. As shown in the table, of the nine ships, five were later canceled, leaving four ships in place through FY2009—LCSs 1 and 2, and the two LCSs funded in FY2009. Ship designations LCS-3 and LCS-4 are being reused as the designations for the two ships funded in FY2009.

⁵⁸ Department of Defense News Release No. 422-07, April 12, 2007, “Navy Terminates Littoral Combat Ship 3.”

⁵⁹ Geoff Fein, “Navy Seeking To Negotiate FPI Contract With General Dynamics,” *Defense Daily*, September 24, 2007; Geoff Fein, “Navy, General Dynamics Meet To Discuss New LCS Fixed Price Structure,” *Defense Daily*, September 27, 2007; Tony Capaccio, “General Dynamics Urged To Take Fixed Price On Warship Contract,” *Bloomberg News*, September 28, 2007; Jason Sherman, “Navy, General Dynamics Discuss Fixed-Price Contract For LCS,” *Inside the Navy*, October 1, 2007.

⁶⁰ Department of Defense News Release No. 1269-07, November 1, 2007, “Navy Terminates Littoral Combat Ship (LCS 4) Contract.”

Table D-I. Status of LCSs Funded in FY2005-FY2009

FY funded	Navy hull designation	Status
2005	LCS-1	Commissioned into service on November 8, 2008. This ship is included in Table I .
2006	LCS-2	Commissioned into service on January 16, 2010. This ship is included in Table I .
	LCS-3 (not the same ship as LCS-3 below)	Canceled by Navy in April 2007 after being placed under contract due to inability to come to agreement with contractor on revised (fixed-price) contract terms for LCSs 1 and 3. This ship is not included in Table I .
	LCS-4 (not the same ship as LCS-4 below)	Canceled by Navy in November 2007 after being placed under contract due to inability to come to agreement with contractor on revised (fixed-price) contract terms for LCSs 2 and 4. This ship is not included in Table I .
2007	none (ship canceled before being placed under contract)	Canceled by Navy in March 2007 before being placed under contract as part of Navy's LCS program restructuring; funds reapplied to cover other program costs. This ship is not included in Table I .
	none (ship canceled before being placed under contract)	Canceled by Navy in March 2007 before being placed under contract as part of Navy's LCS program restructuring; funds reapplied to cover other program costs. This ship is not included in Table I .
2008	LCS-5 (for a while, at least, although the ship was canceled before being placed under contract; the ship designation is now being used for the first of the two ships funded in FY2010)	Canceled by Navy following Congress's decision in September 2008, as part of its action on the FY2009 defense appropriations bill, to rescind the funding for the ship. This ship is not included in Table I .
2009	LCS-3 (not the same ship as LCS-3 above; the ship designation is being reused)	Under construction. This ship is included in Table I .
	LCS-4 (not the same ship as LCS-4 above; the ship designation is being reused)	Under construction. This ship is included in Table I .

Source: Prepared by CRS.

Appendix E. Down Select Acquisition Strategy Announced in September 2009

This appendix presents additional background information on the down select acquisition strategy announced by the Navy on September 16, 2009.

DOD and Navy Background Information

A September 16, 2009, Department of Defense (DOD) news release on the proposed down select strategy stated:

The Navy announced today it will down select between the two Littoral Combat Ship (LCS) designs in fiscal 2010. The current LCS seaframe construction solicitation [for the FY2010 LCSs] will be cancelled and a new solicitation will be issued. At down select, a single prime contractor and shipyard will be awarded a fixed price incentive contract for up to 10 ships with two ships in fiscal 2010 and options through fiscal 2014. This decision was reached after careful review of the fiscal 2010 industry bids, consideration of total program costs, and ongoing discussions with Congress.

“This change to increase competition is required so we can build the LCS at an affordable price,” said Ray Mabus, secretary of the Navy. “LCS is vital to our Navy’s future. It must succeed.”

“Both ships meet our operational requirements and we need LCS now to meet the warfighters’ needs,” said Adm. Gary Roughead, chief of naval operations. “Down selecting now will improve affordability and will allow us to build LCS at a realistic cost and not compromise critical warfighting capabilities.”

The Navy cancelled the solicitation to procure up to three LCS Flight 0+ ships in fiscal 2010 due to affordability. Based on proposals received this summer, it was not possible to execute the LCS program under the current acquisition strategy and given the expectation of constrained budgets. The new LCS acquisition strategy improves affordability by competitively awarding a larger number of ships across several years to one source. The Navy will accomplish this goal by issuing a new fixed price incentive solicitation for a down select to one of the two designs beginning in fiscal 2010.

Both industry teams will have the opportunity to submit proposals for the fiscal 2010 ships under the new solicitation. The selected industry team will deliver a quality technical data package, allowing the Navy to open competition for a second source for the selected design beginning in fiscal 2012. The winner of the down select will be awarded a contract for up to 10 ships from fiscal 2010 through fiscal 2014, and also provide combat systems for up to five additional ships provided by a second source. Delivery of LCS 2, along with construction of LCS 3 and LCS 4 will not be affected by the decision. This plan ensures the best value for the Navy, continues to fill critical warfighting gaps, reduces program ownership costs, and meets the spirit and intent of the Weapons System Acquisition Reform Act of 2009....

The Navy remains committed to the LCS program and the requirement for 55 of these ships to provide combatant commanders with the capability to defeat anti-access threats in the littorals, including fast surface craft, quiet submarines and various types of mines. The

Navy's acquisition strategy will be guided by cost and performance of the respective designs as well as options for sustaining competition throughout the life of the program.⁶¹

A September 16, 2009, e-mail from the Navy to CRS provided additional information on the proposed down select strategy, stating:

The Navy remains committed to a 55 ship LCS program and intends to procure these ships through an acquisition strategy that leverages competition, fixed price contracting and stability in order to meet our overarching objectives of performance and affordability.

In the best interest of the Government, the Navy cancelled the solicitation to procure up to three LCS Flight 0+ ships in FY10 due to affordability.

Based on proposals received in August, the Navy had no reasonable basis to find that the LCS Program would be executable going forward under the current acquisition strategy, given the expectation of constrained budgets.

In the near future, and working closely with Congress, the Navy will issue a new FY10 solicitation which downselects between the two existing designs and calls for building two ships in FY10 and provides options for two additional ships per year from FY11 to FY14 for a total of ten ships. The intent is for all of these ships to be built in one shipyard, which will benefit from a stable order quantity, training and production efficiencies to drive costs down. Both industry teams will have the opportunity to submit proposals for the FY10 ships under the new solicitation.

To sustain competition throughout the life of the program and in conjunction with the downselect, the Navy will develop a complete Technical Data Package which will be used to open competition for a second source of the selected design in FY12, awarding one ship with options for up to four additional ships through FY14, to a new shipbuilder.

Our FY10 solicitation will call for the prime to build an additional five combat systems to be delivered as government-furnished equipment for this second source shipyard. Separating the ship and combat systems procurement will enable bringing the LCS combat system into the broader Navy's open architecture plan.

In short, this strategy calls for two shipbuilders in continuous competition for a single LCS seaframe design, and a government-provided combat system.

The revised strategy meets the full spirit and intent of the Weapon Systems Acquisition Reform Act of 2009 by increasing Government oversight, employing fixed price contract types, maximizing competition, leveraging open architecture, using Economic Order Quantity and Block Buy strategies, and ensuring future competition for shipbuilding as enabled by development of a Technical Data Package to solicit ships from a second shipyard.

We also continue to work closely with Congress on the Navy's LCS procurement intentions....

The Navy intends to continue with construction and delivery of LCS 3 and LCS 4, ultimately for use as deployable assets. We will continue to explore all avenues to ensure this is an affordable program.⁶²

⁶¹ Department of Defense, "Littoral Combat Ship Down Select Announced," News Release 722-09, September 16, 2009, available online at <http://www.defenselink.mil/releases/release.aspx?releaseid=12984>.

The Navy briefed CRS and CBO about the proposed down select strategy on September 22, 2009. Points made by the Navy in the briefing included the following:

- The bids from the two industry teams for the three LCSs requested in the FY2010 budget (which were submitted to the Navy in late July or early August 2009⁶³) were above the LCS unit procurement cost cap in “all scenarios.”
- Negotiations with the industry teams were deemed by the Navy to be not likely to result in award prices for the FY2010 ships that were acceptable to the Navy.
- The Navy judged that the current LCS teaming arrangements “considerably influenced costs” in the FY2010 bids.
- The Navy judged that it cannot afford more than a two-ship award in FY2010 within the amount of funding (\$1,380 million) requested for LCS sea frame procurement in FY2010.
- In response to the above points, the Navy decided to seek a new acquisition strategy for LCSs procured in FY2010 and subsequent years that would make the LCS program affordable by leveraging competition, providing stability to LCS shipyards and suppliers, producing LCSs at efficient rates, giving industry incentives to make investments that would reduce LCS production costs, and increase commonality in the resulting LCS fleet.
- Under the Navy’s proposed strategy, the winner of the LCS down select would be awarded a contract to build two ships procured in FY2010, with options to build two more ships per year in FY2011-FY2014. The contract would be a block-buy contract augmented with Economic Order Quantity (EOQ) authority, so as to permit up-front batch purchases of long leadtime components, as would be the case under a multiyear procurement (MYP) contract. Unlike an MYP contract, however, the block buy contract would not include a termination liability.
- The winner of the down select would deliver to the Navy a technical data package that would permit another shipyard to build the winning LCS design.
- The Navy would hold a second competition to select a second LCS bidder. This competition would be open to all firms other than the shipyard that is building the 10 LCSs in FY2010-FY2014. The winner of this second competition would be awarded a contract to build up to five LCSs in FY2012-FY2014 (one ship in FY2012, and two ships per year in FY2013-FY2014).
- The Navy would maintain competition between the two shipyards for LCSs procured in FY2015 and subsequent years.
- The prime contractor on the team that wins the LCS down select (i.e., Lockheed or General Dynamics) would provide the combat systems for all the LCSs to be

(...continued)

⁶² Email from Navy Office of Legislative Affairs to CRS, entitled “LCS Way Ahead,” September 16, 2009.

⁶³ See, for example, Christopher P. Cavas, “LCS Bids Submitted to U.S. Navy,” *DefenseNews.com*, August 3, 2009, which states: “Lockheed Martin announced its proposal was sent to the Navy on July 31, and rival General Dynamics confirmed its plans were sent in by the Aug. 3 deadline.” See also Bettina H. Chavanne, “Lockheed Submits First LCS Proposal Under Cost Cap Regulations,” *Aerospace Daily & Defense Report*, August 4, 2009: 5.

- procured in FY2010-FY2014—the 10 that would be built by the first shipyard, and the others that would be built by the second shipyard.
- The structure of the industry team that wins the down select would be altered, with the prime contractor on the team being separated from the shipyard (i.e., the shipyard building the 10 LCSs in FY2010-FY2014). The separation, which would occur some time between FY2010 and FY2014, would be intended in part to prevent an organizational conflict of interest on the part of the prime contractor as it provides combat systems to the two shipyards building LCSs.
 - The current combat system used on the selected LCS design will be modified over time to a configuration that increases its commonality with one or more of the Navy's existing surface ship combat systems.
 - The Navy intends to complete the construction and delivery of LCS-3 and LCS-4.
 - The Navy believes that the proposed acquisition strategy does the following: maximize the use of competition in awarding contracts for LCSs procured in FY2010-FY2014; provide an opportunity for achieving EOQ savings with vendors; provide stability and efficient production quantities to the shipyards and vendors; provide an opportunity to move to a common combat system for the LCS fleet; and provide the lowest-possible total ownership cost for the Navy for the resulting LCS fleet, in large part because the fleet would consist primarily of a single LCS design with a single logistics support system. The Navy also believes the proposed strategy is consistent with the spirit and intent of the Weapon Systems Acquisition Reform Act of 2009 (S. 454/P.L. 111-23 of May 22, 2009).

Regarding the Navy's ability to sustain a competition between two LCS builders for LCS construction contracts years from now, when the annual LCS procurement rate is projected to drop to 1.5 ships per year (i.e., a 1-2-1-2 pattern), Under Secretary of the Navy Robert Work reportedly stated:

“We are going to be able to compete those. We will be able to compete three [ships] every two years and one of the yards will win two and one yard will win one. Sometimes, we'll do a five multi-year [procurement contract]. We have all sorts of flexibility in here,” he said.⁶⁴

Potential Oversight Questions for Congress

Prior to the Navy's November 3, 2010, proposal for a dual-award acquisition strategy, the proposed down select strategy posed several potential oversight questions for Congress, including the following:

- Did the timing of the Navy's September 2009 announcement of the strategy—very late in the congressional process for reviewing, marking up, and finalizing action on the FY2010 defense budget—provide Congress with sufficient time to

⁶⁴ Geoff Fein, “Official: Navy OK With Either LCS, New Acquisition Plan Adds Flexibility In Out Years,” *Defense Daily*, February 18, 2010: 3.

adequately review the proposal prior to finalizing its action on the FY2010 defense budget?

- Does the Navy's proposed strategy allow the Navy enough time to adequately evaluate the operational characteristics of the two LCS designs before selecting one of those designs for all future production?
- Does the Navy's proposed method for conducting the LCS down select—the Request for Proposals (RFP)—appropriately balance procurement cost against other criteria, such as life-cycle operation and support (O&S) cost and ship capability?
- What risks would the Navy face if the shipyard that wins the competition to build the 10 LCSs in FY2010-FY2014 cannot build them within the contracted cost?
- How does the Navy plan to evolve the combat system on the winning LCS design to a configuration that has greater commonality with one or more existing Navy surface ship combat systems?
- What are the Navy's longer-term plans regarding the two “orphan” LCSs that are built to the design that is not chosen in the down select?
- What potential alternatives are there to this acquisition strategy?

Each of these questions is discussed briefly below.

Enough Time for Adequate Congressional Review of Navy Proposal?

One potential issue for Congress concerning the proposed down select strategy was whether the timing of the Navy's September 2009 announcement of the strategy—very late in the congressional process for reviewing, marking up, and finalizing action on the FY2010 defense budget—provided Congress with sufficient time to adequately review the proposal prior to finalizing its action on the FY2010 defense budget. The announcement of the Navy's proposed acquisition strategy on September 16, 2009, came

- after the defense committees of Congress had held their hearings to review the FY2010 budget submission;
- after the FY2010 defense authorization bill (H.R. 2647/S. 1390) and the Department of Defense (DOD) appropriations bill (H.R. 3326) had been reported in the House and Senate;
- after both the House and Senate had amended and passed their versions of the FY2010 defense authorization bill, setting the stage for the conference on that bill; and
- after the House had passed its version of the FY2010 DOD appropriations bill.

The timing of the Navy's announcement was a byproduct of the fact that the Navy was not able to see and evaluate the industry bids for the three LCSs that the Navy had originally requested for FY2010 until August 2009. The September 16, 2009, announcement date may have been the earliest possible announcement date, given the time the Navy needed to consider the situation created by the bids, evaluate potential courses of action, and select the proposed acquisition strategy.

Although the Navy might not have been able to present the proposed down select strategy to Congress any sooner than September 16, the timing of the Navy's announcement nevertheless put Congress in the position of being asked to approve a major proposal for the LCS program—a proposal that would determine the basic shape of the acquisition strategy for the program for many years into the future—with little or no opportunity for formal congressional review and consideration through hearings and committee markup activities.

A shortage of time for formal congressional review and consideration would be a potential oversight issue for Congress for any large weapon acquisition program, but this might have been especially the case for the LCS program, because it was not the first time that the Navy put Congress in the position of having to make a significant decision about the LCS program with little or no opportunity for formal congressional review and consideration. As discussed in previous CRS reporting on the LCS program, a roughly similar situation occurred in the summer of 2002, after Congress had completed its budget-review hearings on the proposed FY2003 budget, when the Navy submitted a late request for the research and development funding that effectively started the LCS program.⁶⁵

⁶⁵ The issue of whether Congress was given sufficient time to review and consider the merits of the LCS program in its early stages was discussed through multiple editions of past CRS reports covering the LCS program. The discussion in those reports raised the question of whether “Navy officials adopted a rapid acquisition strategy for the LCS program in part to limit the amount of time available to Congress to assess the merits of the LCS program and thereby effectively rush Congress into approving the start of LCS procurement before Congress fully understands the details of the program.” The discussion continued:

With regard to the possibility of rushing Congress into a quick decision on LCS procurement, it can be noted that announcing the LCS program in November 2001 and subsequently proposing to start procurement in FY2005 resulted in a situation of Congress having only three annual budget-review seasons to learn about the new LCS program, assess its merits against other competing DOD priorities, and make a decision on whether to approve the start of procurement. These three annual budget-review seasons would occur in 2002, 2003, and 2004, when Congress would review the Navy's proposed FY2003, FY2004, and FY2005 budgets, respectively. Congress' opportunity to conduct a thorough review of the LCS program in the first two of these three years, moreover, may have been hampered:

- **2002 budget-review season (for FY2003 budget).** The Navy's original FY2003 budget request, submitted to Congress in February 2002, contained no apparent funding for development of the LCS. In addition, the Navy in early 2002 had not yet announced that it intended to employ a rapid acquisition strategy for the LCS program. As a result, in the early months of 2002, there may have been little reason within Congress to view the LCS program as a significant FY2003 budget-review issue. In the middle of 2002, the Navy submitted an amended request asking for \$33 million in FY2003 development funding for the LCS program. Navy officials explained that they did not decide until the middle of 2002 that they wanted to pursue a rapid acquisition strategy for the LCS program, and consequently did not realize until then that there was a need to request \$33 million in FY2003 funding for the program. By the middle of 2002, however, the House and Senate Armed Services committees had already held their spring FY2003 budget-review hearings and marked up their respective versions of the FY2003 defense authorization bill. These two committees thus did not have an opportunity to use the spring 2002 budget-review season to review in detail the Navy's accelerated acquisition plan for the LCS program or the supporting request for \$33 million in funding.
- **2003 budget-review season (for FY2004 budget).** To support a more informed review of the LCS program during the spring 2003 budget-review season, the conferees on the FY2003 defense authorization bill included a provision (Section 218) requiring the Navy to submit a detailed report on several aspects of the LCS program, including its acquisition strategy. In response to this legislation, the Navy in February 2003 submitted a report of eight pages in length, including a title page and a first page devoted mostly to a restatement of Section 218's requirement for the report. The House and Senate Armed Services committees, in their reports

(continued...)

Supporters of the idea of approving the Navy's proposed down select strategy as part of Congress's work to finalize action on the FY2010 defense budget could argue one or more of the following:

- The timing of the Navy's proposal, though not convenient for Congress, nevertheless represented a good-faith effort by the Navy to present the proposal to Congress at the earliest possible date. The Navy conducted multiple briefings with congressional offices starting in September 2009 to explain the proposed strategy.
- The LCS program needed to be put on a more stable long-term path as soon as possible, and if Congress did not approve the proposal as part of its work in finalizing action on the FY2010 defense budget, another year would pass before the LCS program could be put on a stable path approved by Congress.
- Although cost growth and construction problems with the LCS program can be viewed as a consequence of past attempts to move ahead too quickly on the LCS program, the Navy's acquisition strategy does not risk repeating this experience, because it does not represent another attempt to move ahead on the program at an imprudent speed. To the contrary, the strategy seeks to reduce execution risks by limiting LCS procurement to a maximum of four ships per year and providing a stable planning environment for LCS shipyards and suppliers.
- If the proposed strategy were not approved by Congress as part of its action on the FY2010 budget, the LCSs procured in FY2010 would be more expensive to procure, since they would not benefit from economies of scale that would come from awarding the FY2010 ships as part of a contract that also includes LCSs to be procured in FY2011-FY2014.

Supporters of the idea of deferring a decision on the Navy's proposed down select strategy until the FY2011 budget cycle could argue one or more of the following:

- Navy briefings to Congress on the proposed strategy starting in September 2009, though helpful, were not sufficient for Congress to fully understand the features and potential implications of the Navy's proposed acquisition strategy—much less the relative merits of potential alternatives to that strategy.
- The risks of making a quick decision on the Navy's proposed acquisition strategy, with little time for formal congressional review and consideration, are underscored by the history of the LCS program, which includes substantial cost growth and construction problems that can be viewed as the consequence of past

(...continued)

on the FY2004 defense authorization bill, have expressed dissatisfaction with the thoroughness of the report as a response to the requirements of Section 218. (For details, see the "Legislative Activity" section of this report.) It is thus not clear whether the defense authorization committees were able to conduct their spring 2003 budget-review hearings on the FY2004 budget with as much information about the LCS program as they might have preferred.

(See, for example, CRS Report RL 32109, *Navy DD(X), CG(X), and LCS Ship Acquisition Programs: Oversight Issues and Options for Congress*, by Ronald O'Rourke, updated July 29, 2005, pp. CRS-59 to CRS-60. This discussion was carried through multiple updates of CRS reports covering the LCS program.)

- attempts to move ahead quickly on the program, without more-extensive congressional review and consideration.
- The desire to avoid paying a relatively high cost for LCSs procured in FY2010, though real, should not have been a controlling factor in this situation (i.e., should not have been “the tail that wags the dog”). Paying a higher cost for LCSs procured in FY2010, though not optimal, would be an investment to buy time for Congress to more fully review and consider the merits of both the Navy’s proposal and potential alternatives to it. Problems avoided through a full congressional review and consideration of the Navy’s proposal and potential alternatives during the FY2011 budget cycle could eventually save the Navy a lot more money than the Navy hopes to save on the LCSs procured in FY2010 by procuring them as part of a contract that also includes LCSs to be procured in FY2011-FY2014.
 - Approving the Navy’s proposed acquisition strategy at a late juncture in the annual congressional process for reviewing and marking up the defense budget would set an undesirable precedent from Congress’s standpoint regarding late submissions to Congress of significant proposals for large defense acquisition programs, and encourage DOD to do the same with other large weapon acquisition programs in the future in the hopes of stampeding Congress into making quick decisions on major proposals for those programs.

Enough Time to Evaluate the Two Designs’ Operational Characteristics?

Another potential issue for Congress concerning the Navy’s down select strategy was whether the strategy allowed the Navy enough time to adequately evaluate the operational characteristics of the two LCS designs before selecting one of those designs for all future production. Potential oversight questions for Congress included the following:

- Since LCS-1 as of September 2009 had been in commissioned service for less than a year, and LCS-2 as of that date had not yet been delivered to the Navy, how firm was the basis for the Navy’s determination that both LCS designs meet the Navy’s operational requirements for LCS?
- By the summer of 2010—when the Navy plans to award a contract to the winner of the down select—the Navy will have had only a limited time to evaluate the operational characteristics of LCS-1 and LCS-2 through fleet exercises and use in actual Navy deployments. Will the Navy at that point have a sufficient understanding of the two designs’ operational characteristics to appropriately treat the operational characteristics of the two designs in the down select?

The Navy and its supporters could argue that the Navy has chosen a preferred design for other new Navy ships (such as the DDG-1000 destroyer) on the basis of paper designs only, and consequently that the Navy would have a firmer basis for performing the LCS down select than it has had on other shipbuilding programs. They can argue that the Navy has a good understanding of the basic differences between the ships—that the Lockheed design, for example, may have better features for supporting small boat operations (which are used for certain LCS missions), while the General Dynamics design may have better features for supporting helicopter and unmanned aerial vehicle (UAV) operations (which are used for certain LCS missions).

Skeptics could argue that the Navy in the past has talked about performing an extensive operational review of each design prior to settling on an acquisition strategy for follow-on ships in the program, and that the innovative nature of the LCS—a modular ship with plug-and-fight mission packages and a small crew—increases the risks associated with selecting a single LCS design before performing such an extensive operational review. Skeptics could argue that the Navy is depriving itself of the opportunity to better understand, through exercises and real-world deployments, the implications for overall fleet operations of building all LCSs to one design or the other before performing the down select.

Weight Given to Procurement Cost vs. Other Factors in Request for Proposals (RFP)

Another potential issue for Congress concerning the Navy's down select strategy concerned the criteria that the Navy will use for selecting a winning design in the down select. Some observers, particularly supporters of the General Dynamics LCS design, argued that the Navy's proposed method for evaluating the two LCS designs in the LCS down select—set forth in the Request for Proposals (RFP) for the down select—focused too much on procurement cost and not enough on other factors, particularly life-cycle fuel cost, other components of life-cycle operating and support (O&S) cost, and ship capability. Other observers, particularly supporters of the Lockheed LCS design, argued (as did the Navy) that the Navy's proposed method for conducting the LCS down select adequately took into account factors other than procurement cost. The issue was viewed as having the potential for leading to a protest of the Navy's down select decision by the firm that is not selected.⁶⁶

Regarding the role of life-cycle operation and support (O&S) cost in the Navy's down select decision, a February 2010 GAO report stated:

The Navy estimated operating and support costs for LCS seaframes and mission packages in 2009, but the estimates do not fully reflect DOD and GAO best practices for cost estimating and may change due to program uncertainties. GAO's analysis of the Navy's 2009 estimates showed that the operating and support costs for seaframes and mission packages could total \$84 billion (in constant fiscal year 2009 dollars) through about 2050. However, the Navy did not follow some best practices for developing an estimate such as (1) analyzing the likelihood that the costs could be greater than estimated, (2) fully assessing how the estimate may change as key assumptions change, and (3) requesting an independent estimate and comparing it with the program estimate. The estimates may also be affected by program uncertainties, such as potential changes to force structure that could alter the number of ships and mission packages required. The costs to operate and support a weapon system can total 70 percent of a system's costs, and the lack of an estimate that fully reflects best practices

⁶⁶ For examples of articles discussing this issue, see Sean Reilly, "Loser To Fight In LCS Deal?" *Mobile (AL) Press-Register*, March 28, 2010: 1; Cid Standifer, "Austal USA, GD Officials Criticize Navy's RFP Criteria For LCS Award," *Inside the Navy*, March 29, 2010; Zachary M. Peterson, "Navy LCS Proposal Request Seeks 'Qualitative' Total Ownership Cost Figures," *Inside the Navy*, March 22, 2010; Emelie Rutherford, "Navy Stands By LCS Due Date As Hill Backers Of Each Bidder Swap Barbs," *Defense Daily*, March 18, 2010: 2-3; Geoff Fein, "General Dynamics' LCS Burns Less Fuel At Higher Speeds, Navy Documents Show," *Defense Daily*, March 2, 2010: 1-2; Geoff Fein, "Sessions Presses Navy Over Fairness of LCS RFP Evaluation," *Defense Daily*, March 1, 2010: 6-7; Geoff Fein, "USS Independence [LCS-2] Is The More Fuel Efficient of Two LCS Variants, Austal Official Says," *Defense Daily*, February 24, 2010: 2-3; Geoff Fein, "LCS RFP: Greater Emphasis Placed On Ship Price, Less On Life-Cycle Cost," *Defense Daily*, January 29, 2010: 5-7; Christopher P. Cavas, "RFP for LCS: Cost Main Factor in Winning Bid," *NavyTimes.com*, January 28, 2010.

could limit decision makers' ability to identify the resources that will be needed over the long term to support the planned investment in LCS force structure. With a decision pending in 2010 on which seaframe to buy for the remainder of the program, decision makers could lack critical information to assess the full costs of the alternatives.⁶⁷

A February 8, 2010, press report stated that "the Navy will draw up total life-cycle cost estimates for both the Lockheed Martin and General Dynamics versions of the Littoral Combat Ship before the program goes before the Defense Acquisition Board this year for its Milestone B. review. The service included the announcement in a response to a Government Accountability Office report that criticized LCS life-cycle estimates."⁶⁸

At the request of Senator Jeff Sessions, the CBO analyzed the impact of O&S cost and other types of costs on the total life-cycle costs of the LCS and (for purposes of comparison) four other types of Navy ships. The results of CBO's analysis were released in the form of an April 28, 2010, letter to Senator Sessions. The letter states:

CBO projected the life-cycle cost of the LCS-1 under three different assumptions about the average annual amount of fuel the ship will use over its 25-year life: low, moderate, and high. In all three scenarios, procurement costs dominate the life-cycle cost of the LCS-1, ranging from 58 percent to 66 percent of the total.... Personnel costs make up 14 percent to 16 percent of the LCS-1's total life-cycle cost in the various scenarios, and fuel costs account for 8 percent to 18 percent.

The low-fuel case assumes that the LCS-1 generally operates at relatively low speeds—10 knots or less 90 percent of the time it is under way and 30 knots or more only about 3 percent of the time. That speed profile is based in part on how the Navy operated the LCS-1 between March 2009 and March 2010. In that scenario, operation and support costs total 33 percent of the ship's life-cycle cost: 16 percent for personnel costs, 8 percent for fuel costs (assuming that the ship consumes 25,000 barrels of fuel per year), and 9 percent for other O&S costs....

The moderate-fuel case—which CBO considers the most likely of the three scenarios—assumes that the LCS-1 operates at 30 or more knots for about 5 percent of the time, at 14 knots to 16 knots 42 percent of the time (a range that might be typical when the ship was traveling from its home port to a deployment location), and at less than 12 knots for the rest of its time under way. In that scenario, O&S costs total 34 percent of the ship's life-cycle cost: 15 percent for personnel, 11 percent for fuel, and 8 percent for other O&S costs. The moderate speed profile would result in fuel usage of about 35,000 barrels per year, slightly less than the 37,600 barrels that the Navy assumed in formulating its 2011 budget request. By comparison, the [Navy's] FFG-7 class frigates consumed about 31,000 barrels of fuel per ship in 2009.

The high-fuel case assumes that the LCS-1 operates at 30 or more knots for about 20 percent of its time under way, an assumption based partly on a speed profile developed by the Naval Sea Systems Command for the LCS program. In that scenario, O&S costs represent about 40 percent of the ship's life-cycle cost—more than in the other scenarios for the LCS-1 but less than for any of the other types of ships considered in this analysis. Personnel costs make up 14 percent of the life-cycle total; fuel costs, 18 percent; and other O&S costs, 8 percent.

⁶⁷ Government Accountability Office, *Littoral Combat Ship[:] Actions Needed to Improve Operating Cost Estimates and Mitigate Risks in Implementing New Concepts*, GAO-10-257, February 2010, summary page.

⁶⁸ Cid Standifer, "Navy Will Project Operation Costs Of Both LCS Models for DAB Review," *Inside the Navy*, February 8, 2010.

Projected fuel usage in this scenario is about 67,000 barrels per year. That estimate is unlikely to be exceeded in actual practice: It is twice the historical average for frigates and about 80 percent of the amount used by the Navy's destroyers (which do not have the capability to speed at 40 knots, as the littoral combat ship does, but are three times larger than the LCS-1).⁶⁹

At a May 6, 2010, hearing on Navy shipbuilding programs before the Seapower Subcommittee of the Senate Armed Services Committee, Senator Sessions questioned Sean Stackley, the Navy's acquisition executive (i.e., the Assistant Secretary of the Navy [Research, Development and Acquisition]), regarding the role of fuel costs in the Navy's evaluation of the two LCS designs.

Potential Risks If First Shipyard Cannot Build Ships Within Cost

Another potential issue for Congress concerning the Navy's down select strategy concerned the potential risks the Navy would face if the shipyard that wins the competition to build the 10 LCSs in FY2010-FY2014 cannot build them within the contracted cost. The competition between the two existing LCS industry teams to be the winner of the down select could be intense enough to encourage the teams to bid unrealistically low prices for the contract to build the 10 ships.

The Navy and its supporters could argue that the Navy's plan to award a fixed-price contract to the winner of the down select would shift the cost risk on the 10 ships from the government to the shipyard. They could also argue that the Navy plans to carefully evaluate the bid prices submitted by the two industry teams for the down select to ensure that they are realistic, and that the existence of the second LCS shipyard would provide the Navy with an ability to continue building LCSs if production at the first yard were disrupted due to financial issues.

Skeptics could argue that even with a fixed-price contract, the Navy's proposed strategy poses cost risks for the government, because a shipyard could submit an unrealistically low bid so as to win the down select, and then recover its losses on those 10 ships by rolling the losses into prices for downstream ships in the program. Alternatively, the shipyard could present the Navy with the prospect of going out of business and disrupting the LCS production effort unless the Navy were to provide a financial bailout to cover the yard's losses on the 10 ships. Skeptics could argue that Navy decisions dating back to the 1970s to award multi-ship construction contracts to shipyards that had not yet built many ships of the kind in question sometimes led to less-than-satisfactory program outcomes, including substantial financial bailouts.

Increasing LCS Combat System Commonality with Other Combat Systems

Another potential issue for Congress regarding the Navy's down select strategy concerned the Navy's plan to evolve the combat system on the winning LCS design to a configuration that has greater commonality with one or more existing Navy surface ship combat systems. The Navy in its September 16, 2009, announcement did not provide many details on this part of its proposed acquisition strategy, making it difficult to evaluate the potential costs and risks of this part of the strategy against potential alternatives, including an alternative (which Navy officials have discussed in the past) of designing a new LCS combat system that would, from the outset, be highly common with one or more existing Navy surface ship combat systems.

⁶⁹ Letter dated April 28, 2010, from Douglas W. Elmendorf, Director, CBO, to the Honorable Jeff Sessions, pp. 3-5. The letter is available online at <http://www.cbo.gov/ftpdocs/114xx/doc11431/04-28-SessionsLetter.pdf>.

Navy's Longer-Term Plans Regarding Two "Orphan" Ships

Another potential issue for Congress concerning the Navy's down select strategy concerned the Navy's longer-term plans regarding the two "orphan" LCSs built to the design that was not selected in the down select. The Navy stated that it planned to keep these two ships in the fleet because they will be capable ships and the Navy has an urgent need for LCSs. These two LCSs, however, will have unique logistic support needs, potentially making them relatively expensive to operate and support. At some point, as larger numbers of LCSs enter service, the costs of operating and supporting these two ships may begin to outweigh the increasingly marginal addition they make to total LCS fleet capabilities. Potential alternatives to keeping the ships in the active-duty fleet as deployable assets include selling them to foreign buyers, converting them into research and development platforms, shifting them to the Naval Reserve Force (where they would be operated by crews consisting partially of reservists), or decommissioning them and placing them into preservation (i.e., "mothball") status as potential mobilization assets. Potential questions for Congress included the following:

- Does the Navy intend to keep the two orphan LCSs in the active-duty fleet as deployable assets for a full 25-year service life?
- If so, how would be the life-cycle operation and support (O&S) costs of these two ships compare to those of the other LCSs? In light of these O&S costs, would it be cost effective to keep these two ships in the active-duty fleet as deployable assets for a full 25-year service life, particularly as large numbers of LCSs enter service?
- If the Navy does not intend to keep the two orphan LCSs in the active-duty fleet as deployable assets for a full 25-year service life, when does the Navy anticipate removing them from such service, and what does the Navy anticipate doing with them afterward?

Potential Alternatives to Navy's September 2009 Strategy

Another potential issue for Congress concerning the Navy's down select strategy concerned potential alternatives to that strategy. A variety of alternatives can be generated by changing one or more elements of the Navy's proposed strategy. One alternative would be a strategy that would keep both LCS designs in production, at least for the time being. Such a strategy might involve the following:

- the use of block-buy contracts with augmented EOQ authority, as under the Navy's proposed acquisition strategy, to continue producing both LCS designs, so as to provide stability to shipyards and suppliers involved in producing both LCS designs;
- the use of Profit Related to Offer (PRO) bidding between the builders of the two LCS designs, so as to generate competitive pressure between them and thereby restrain LCS production costs;⁷⁰ and

⁷⁰ Under PRO bidding, the two shipyards would compete not for LCS quantities (because each shipyard would know that it was going to build a certain number of LCSs over the term of their block-buy contracts), but rather for profit, with the lowest bidder receiving the higher profit margin. PRO bidding has been used in other defense acquisition programs where bidders do not compete for quantity. The Navy, for example, began using PRO bidding in the DDG-51 (continued...)

- designing a new LCS combat system that would have a high degree of commonality with one or more existing Navy surface ship combat systems and be provided as government-furnished equipment (GFE) for use on both LCS designs—an idea that was considered by the Navy at an earlier point in the program.

The Navy's November 3, 2010, proposal for a dual-award LCS acquisition strategy is broadly similar to the notional dual-award approach outlined above. This notional dual-award approach has been presented in this CRS report as an option for Congress since September 27, 2009, when the report was updated to incorporate the Navy's September 16, 2009, announcement of its proposed down select strategy. The discussion below concerns the notional dual-award approach outlined above.

Supporters of an alternative like the one outlined above could argue that it would

- provide stability to LCS shipyards and suppliers;
- use competition to restrain LCS production costs;
- permit the Navy to receive a full return on the investment the Navy made in creating both LCS designs;
- reduce the life-cycle operation and support costs associated with building two LCS designs by equipping all LCSs with a common combat system;
- allow the Navy to design an LCS combat system that is, from the outset, highly common with one or more of the Navy's existing surface ship combat systems;
- achieve a maximum LCS procurement rate of four ships per year starting in FY2011 (two years earlier than under the Navy's proposal), thus permitting more LCSs to enter service with the Navy sooner;
- build both LCS designs in substantial numbers, thereby avoiding a situation of having a small number of orphan LCS ships that could have potentially high operation and support costs;
- preserve a potential to neck down to a single LCS design at some point in the future, while permitting the Navy in the meantime to more fully evaluate the operational characteristics of the two designs in real-world deployments; and
- increase the potential for achieving foreign sales of LCSs (which can reduce production costs for LCSs made for the U.S. Navy) by offering potential foreign buyers two LCS designs with active production lines.

Supporters of the Navy's proposed acquisition strategy could argue that an alternative like the one outlined above would, compared to the Navy's proposed strategy

- achieve lower economies of scale in LCS production costs by splitting production of LCS components between two designs;

(...continued)

destroyer program it in the 1990s.

- achieve, at the outset of series production of LCSs, less bidding pressure on shipyards, and thus higher LCS production costs, than would be achieved under the Navy's proposed strategy of using a price-based competition to select a single design for all future LCS production;
- miss out on the opportunity to restrain LCS costs by using the level of efficiency achieved in building an LCS design at one shipyard as a directly applicable benchmark for gauging the level of efficiency achieved by the other shipyard in building the same LCS design;
- increase Navy LCS program-management costs and the burden on Navy program-management capabilities by requiring the Navy to continue managing the construction of two very different LCS designs;
- achieve lower economies of scale in LCS operation and support costs because the two LCS designs would still differ in their basic hull, mechanical, and electrical (HM&E) systems, requiring the Navy to maintain two separate HM&E logistics support systems;
- receive only a limited return on the investment the Navy made in developing the two current LCS combat systems (since LCSs in the long run would not use either one), and require the Navy to incur the costs and the technical risks associated with designing a completely new LCS combat system;
- require the Navy to build some number of LCSs with their current combat systems—which are different from one another and from other Navy surface ship combat systems—while awaiting the development of the new LCS combat system, and then incur the costs associated with backfitting these earlier LCSs with the new system when it becomes available;
- send to industry a signal that is undesirable from the government's perspective that if the Navy or other parts of DOD begin producing two designs for a new kind of weapon system, the Navy or DOD would be reluctant to neck production down to a single design at some point, even if government believes that doing so would reduce program costs while still meeting operational objectives; and
- miss out on the opportunity that would be present under the Navy's proposed acquisition strategy to increase the potential for achieving foreign sales of LCSs by offering potential foreign buyers an LCS design that, through U.S. production, enjoys significant economies of scale for both production and operation and support.

Appendix F. Dual-Award Acquisition Strategy Announced in November 2010

This appendix presents additional background information on the dual-award acquisition strategy announced by the Navy on November 3, 2009.

November 4, 2010, Navy Point Paper

A November 4, 2010, Navy point paper on the dual-award strategy proposed on November 3, 2010, stated the following (this is the full text of the point paper):⁷¹

Littoral Combat Ship Proposed Revised Acquisition

Dual Ten Ship Awards

- In summer 2009 Navy received bids for three FY10 ships from Lockheed Martin/Marinette Marine/Bollinger and General Dynamics Bath Iron Works/Austal USA industry teams. These bids did not reflect competitive pricing and well exceeded the Congressional Cost Cap. In order to reverse cost trends on the program, the acquisition strategy was revised to the current down select strategy.
- The Navy's Littoral Combat Ship acquisition strategy to down select to a single design has resulted in a highly effective competition between the industry bidders. Navy is on the path to down select in accordance with the terms of the current solicitation.
- The industry response to the competitive acquisition strategy has resulted in has resulted in reduction in cost for the LCS ships relative to the previous bids. These competitive bids, coupled with Navy's desires to increase ship procurement rates to support operational requirements, has created an opportunity to award each bidder a fixed price ten-ship block buy – a total of 20 ships from Fiscal Year 2010 to Fiscal Year 2015. A comparison between the two strategies of which ships are included in a down select/second source versus dual 10 ship block buy appears in the table below.
- The current NDAA [national defense authorization act] language permits the Navy to procure up to 10 ships in a block buy. In order to execute a dual ten ship award, Navy believes Congressional authorization is required.
- If Congressional support for this approach is granted, Navy will work with industry to revise the ship procurement schedules within current proposal pricing (FY10 – FY15 vice FY10 – FY14).
- Navy is continuing on the path to down select and absent authorization, we will proceed to down select by mid-December 2010.
- There are numerous benefits to this approach including stabilizing the LCS program and the industrial base with award of 20 ships; increasing ship procurement rate to support

⁷¹ Source: Navy point paper on proposed alternative LCS acquisition strategy dated November 4, 2010.

operational requirements; sustaining competition through the program; and enhancing Foreign Military Sales opportunities.

- The Navy intends to procure the Technical Data Package for both designs and if necessary a second source for either or both designs could be brought into the program.
- Either approach will ensure the Navy procures affordably priced ships.

		FY10	FY11	FY12	FY13	FY14	FY15	TOTAL
Downselect	Winner	2	2	2	2	2	4	19
	Second Source			1	2	2		
	TOTAL	2	2	3	4	4	4	
Dual Award	Contractor A	1	1	2	2	2	2	20
	Contractor B	1	1	2	2	2	2	
	TOTAL	2	2	4	4	4	4	

Near-Term Issue for Congress

The Navy's proposed dual-award strategy posed a near-term issue for Congress of whether this strategy would be preferable to the down select strategy, and whether Congress should grant the Navy, by December 30, the additional legislative authority the Navy would need to implement the dual-award strategy.

December 14 Senate Armed Services Committee Hearing

On December 14, 2010, the Senate Armed Services Committee held a hearing to review the Navy's proposed dual-award strategy. The witnesses at the hearing included Navy leaders and representatives from CBO, GAO, and CRS. The committee's web page for the hearing⁷² contains links to the prepared statements of the GAO and CRS witnesses, and states that the Navy and CBO witnesses did not submit their prepared statements in electronic form. (The CBO witness asked in his opening remarks that CBO's December 10, 2010, letter report on the relative costs of the down select and dual-award strategies⁷³ be entered into the record for the hearing. CBO's letter report is available from the CBO website.) The committee's web page for the hearing also contains a link to the transcript of the hearing.

Some General Observations

General observations that could be made on the Navy's proposed dual-award strategy included but are not limited to the following:

⁷² http://armed-services.senate.gov/testimony.cfm?wit_id=9812&id=4897.

⁷³ Congressional Budget Office, letter report to Senator John McCain on LCS acquisition strategies dated December 10, 2010, 7 pp.

- The dual-award strategy would avoid, at least for now, the possibility of a contract protest being filed against a Navy down select decision.
- Although the dual-award strategy includes the possibility of the Navy at some point bringing a second source into the program for either or both LCS designs, the dual-award strategy does not include the guaranteed opportunity present in the down select strategy for shipyards not currently involved in building LCSs to compete for the right to become the second LCS builder.
- The Navy's November 4, 2010, point paper on the dual-award strategy does not outline the Navy's intentions regarding the currently different combat systems (i.e., the built-in collections of sensors, weapons, displays, and software) on the two LCS designs.
- The dual-award strategy would require each LCS contractor to build 10 ships over a period of six years (FY2010-FY2015) rather than five years (FY2010-FY2014), but at the same price that was bid for the five-year schedule. In addition, LCSs built under the dual-award strategy would incorporate combat systems that would be built by combat system manufacturers in smaller annual quantities than would be the case under the down select strategy, possibly increasing the costs of these combat systems. Factors such as these could, at the margin, alter the profitability for each contractor of building its respective group of 10 ships.

It could also be noted that the Navy's proposed dual-award strategy is broadly similar to a notional dual-award approach that was presented in this CRS report as an option for Congress (see **Appendix E**) since September 27, 2009, when the report was updated to incorporate the Navy's September 16, 2009, announcement of its proposed down select strategy.

Potential Oversight Questions for Congress

Potential oversight questions for Congress in assessing whether the proposed dual-award strategy would be preferable to the down select strategy, and whether to grant the Navy, by December 30, the additional legislative authority the Navy would need to implement a dual-award strategy, included but were not limited to the following:

- Did the timing of the Navy's proposal provide Congress with enough time to adequately assess the relative merits of the down select strategy and the dual-award strategy? Given that the contractors submitted their bids by about September 15, could the Navy have notified Congress of the proposed dual-award strategy sooner than November 3, giving Congress more time to seek information on and evaluate the proposal? Should the Navy have asked the contractors to extend their bid prices for another, say, 30 or 60 or 90 days beyond the original December 14 expiration date, so as to provide more time for congressional review of the Navy's proposal?⁷⁴ (As mentioned earlier, on

⁷⁴ A December 6, 2010, press report states: "Lockheed officials have indicated that they could extend the pricing in their proposal for a short while beyond Dec. 14, to allow time for Congress to approve the change. Lockheed Chief Financial Officer Bruce Tanner told an investment conference last week that Lockheed could extend the prices it offered for a day or two, but not indefinitely.... Analysts said they expected both companies to show some flexibility on the expiration of their pricing, given that each firm stood to win a contract valued at around \$5 billion." (Andrea (continued...))

December 13, it was reported that the two LCS bidders, at the Navy's request, had extended the prices in their bids for 16 days, to December 30. At the December 14 hearing, Navy witnesses expressed strong doubts about the willingness of the bidders to extend their bid prices for any significant additional amount of time, since agreements with their parts suppliers and other arrangements on which the bids are based would no longer be valid.)

- What role, if any, did a desire by the Navy to avoid a potential contract protest against the Navy's down select decision play in the Navy's decision to propose the alternate dual-award strategy? For example, how concerned, if at all, was the Navy that the announcement of an LCS down select decision might lead to a contract protest and controversy somewhat like what has been experienced in the Air Force's KC-X aerial refueling tanker acquisition program?⁷⁵ A December 13, 2010, press report on the LCS program stated: "One high-level Navy source recently said that without the dual-ship approach, 'there is 100 percent chance of a protest.'"⁷⁶
- What are the potential relative costs of the down select and dual-award acquisition strategies, including development costs, procurement costs, and life-cycle operation and support (O&S) costs? Did the Navy fully and accurately estimated these costs—including potential costs for developing, procuring, and installing a common combat system for both LCS designs—and reported all these potential costs to Congress?
- What are the potential relative risks of the down select and dual-award acquisition strategies, including development risks, production cost risks, production schedule risks, and life-cycle O&S risks? Did the Navy fully and accurately estimated these risks, and reported all these potential risks to Congress?
- What are the Navy's intentions, under the proposed dual-award acquisition strategy, regarding the currently different combat systems on the two LCS designs? Does the Navy intend to leave them unchanged, adopt one of the combat systems as the common system for both designs, or develop a new combat system for both designs? If the Navy intends to pursue the second or third of these paths, what is the Navy's plan (including schedule) for doing so? If the Navy does not have a definite plan regarding the combat systems for the ships, how well can the potential costs and risks of the dual-award strategy be estimated and compared to those of the down select strategy?
- What are the potential industrial-base impacts of the dual-award strategy, including impacts on the two LCS contractors, on shipyards that could, under the

(...continued)

Shalal-Esa, "U.S. Navy Hopeful Congress Will Approve Ship Buys," *Reuters.com*, December 6, 2010.) Another December 6, 2010, press report that was posted online on December 3, 2010, stated: "Theoretically, Lockheed Martin and Austal could likely agree to extend the price deadline, but the Navy has not asked them to do so yet, [Navy spokeswoman Captain Cate] Mueller said." (Cid Standifer, "Stand-Alone Bill May Be Needed To Approve LCS Dual Block Buy Plan," *Inside the Navy*, December 6, 2010.)

⁷⁵ For more on the KC-X program, see CRS Report RL34398, *Air Force KC-46A Tanker Aircraft Program: Background and Issues for Congress*, by Jeremiah Gertler.

⁷⁶ Christopher P. Cavas, "Deadline Looms For U.S. Navy's LCS," *Defense News*, December 13, 2010: 1.

- down select strategy, bid for the right to become the second LCS builder, and on combat system manufacturers?
- What impact, if any, might the Navy's proposal to shift from its down select strategy to the dual-award strategy have on the ability of the Department of Defense (DOD) to implement down select strategies for other acquisition programs? For example, will the Navy's proposal to shift to the dual-award strategy cause contractors bidding for other acquisition programs to treat with increased skepticism stated DOD intentions to carry out down selects? If so, could that reduce the benefits of competition that DOD might hope to achieve through the use of down select strategies?

Enough Time for Adequate Congressional Review of Navy Proposal?

Regarding whether the timing of the Navy's proposal provides Congress with enough time to adequately assess the relative merits of the down select strategy and the dual-award strategy, it can be noted that this was the third time in the history of the LCS program that the Navy presented Congress with an important choice about the future of the LCS program late in the congressional budget-review cycle, after Congress had completed its spring budget-review hearings and some of its committee markups. The first instance was in mid-2002, when the Navy submitted an amended request to Congress for FY2003 funding to get the LCS program started using a rapid acquisition strategy.⁷⁷ The second was in September 2009, when the Navy announced its proposed down select strategy for the LCS program (see the discussion of this issue in following section on the down select strategy).

In light of the third instance—the Navy's proposal of November 3, 2010, for using a dual-award strategy rather than a down select strategy—a potential issue for Congress are the implications for the LCS program and congressional oversight of defense acquisition programs in general of proceeding with the LCS program in part on the basis of policies originally presented as proposals to Congress late in the congressional budget-review cycle, after Congress had completed its spring budget-review hearings and some of its committee markups. The Navy's November 3, 2010, notification to Congress of the proposed dual-award strategy, combined with a request by the Navy that Congress act on that proposal by December 30, provided relatively little time for Congress to collect cost and other information from the Navy (including information that Navy might not offer in initial briefings to individual congressional offices), for Congress to solicit cost and other information from independent sources such as CBO and GAO,

⁷⁷ The Navy's original FY2003 budget request, submitted to Congress in February 2002, contained no apparent funding for development of the LCS. In addition, the Navy in early 2002 had not yet announced that it intended to employ a rapid acquisition strategy for the LCS program. As a result, in the early months of 2002, there may have been little reason within Congress to view the LCS program as a significant FY2003 budget-review issue. In the middle of 2002, the Navy submitted an amended request asking for \$33 million in FY2003 development funding for the LCS program. Navy officials explained that they did not decide until the middle of 2002 that they wanted to pursue a rapid acquisition strategy for the LCS program, and consequently did not realize until then that there was a need to request \$33 million in FY2003 funding for the program. By the middle of 2002, however, the House and Senate Armed Services committees had already held their spring FY2003 budget-review hearings and marked up their respective versions of the FY2003 defense authorization bill. These two committees thus did not have an opportunity to use the spring 2002 budget-review season to review in detail the Navy's accelerated acquisition plan for the LCS program or the supporting request for \$33 million in funding.

for CBO and GAO to develop such information and provide it to Congress, for Congress to hold hearings at which all this information might be discussed in a group setting, with multiple parties present, and for congressional offices to then form their evaluations of the Navy's proposal.

Relative Costs

Regarding the relative costs of the down select and dual-award acquisition strategies, there were at least three significant cost elements to consider: ship procurement costs; costs for possibly modifying the combat systems on LCSs so as to achieve more commonality in combat system equipment among all LCSs, and between LCSs and other Navy ships; and operational and support (O&S) costs.

Ship Procurement Costs

Navy Estimate

Regarding ship procurement costs, the Navy estimates that procuring LCSs under the dual-award strategy would cost \$1 billion less through *FY2016*, and \$600 million less through *FY2015*, than procuring them under the down select strategy. The Navy states that the \$1 billion in savings through *FY2016* translates to \$910 million in net present value terms, and that the \$600 million in savings through *FY2015* translates to \$496 million in net present value terms.⁷⁸

The Navy estimates that ship procurement costs will be lower under the dual-award strategy than they would have been under the down select strategy due to the following cost factors, which are not listed in any particular order:⁷⁹

- **Costs due to the second source under down select strategy building its first LCS.** The Navy estimates that certain ship procurement costs would be higher under the down select strategy because the second source under the down select strategy—that is, the unknown shipyard that would have been chosen in the second-stage competition that would have occurred under the down select strategy—would be building its first LCS. These higher costs include the following:
 - **Tooling, jigs, fixtures, etc.** The second source under the down select strategy would incur costs for the purchase of LCS-specific tooling, jigs, fixtures, etc. Marinette and Austal already have already paid for these things.
 - **Engineering and support services.** The Navy's estimate includes a higher cost for engineering and support services at the second source under the down select strategy, because these costs typically are higher for a lead ship at a shipyard than for subsequent ships at that yard.
 - **Learning curve position.** In estimating the amount of labor hours required to build the first ship covered under the second source's block-buy contract,

⁷⁸ Source for \$496 million figure: Navy briefing to CRS and CBO, March 30, 2011.

⁷⁹ Source for these points: Navy information paper dated April 12, 2011, as clarified and elaborated in a telephone conversation with CRS on April 21, 2011.

the Navy's estimate takes into account the fact that the second source under the dual-award strategy has already built LCSs (i.e., the yard is already some way down its LCS production learning curve), whereas the second source under the down select strategy would be building its first LCS (i.e., the yard would be at the top of its LCS production learning curve).

- **Change orders.** The Navy budgets a 10% allowance for change orders (i.e., design changes) for a lead ship built at a shipyard, compared to 5% for subsequent ships built at that yard.
- **Rework.** The Navy's estimate includes a higher cost for rework at the second source under the down select strategy because lead ships typically experience higher rework rates.
- **Slope of shipyard learning curve.** The Navy estimates that the second source under the dual-award strategy will achieve a steeper production learning curve (i.e., a greater amount of ship-to-ship reduction in shipyard labor hours required to build each ship) than would have been achieved by the second source under the down select strategy. In making this estimate, the Navy cites facilities improvements at Marinette and Austal that the Navy believes will permit Marinette and Austal to achieve learning curves of a certain steepness.
- **Shipyard labor rates.** The Navy estimates that the second source under the dual-award strategy will feature labor rates that are lower than those that would have occurred at the second source under the down select strategy.
- **Vendor material costs.** The Navy estimates that the second source under the dual-award strategy will obtain lower material prices from vendors than the second source under the down select strategy would have obtained because the second source under the dual-award strategy can seek bids from vendors on materials for a 10-ship contract, while the second source under the down select strategy would have sought bids from vendors on materials for a 5-ship contract.⁸⁰
- **Profit rates.** The Navy estimates that the profit rates earned by second source under the dual-award strategy are lower than those that would be earned by the second source under the down select strategy, due to aggressive bidding by Marinette and Austal during what these yards thought was the first-stage competition under the down select strategy—a competition that was to have chosen the one LCS design to which all future LCSs would be built.

In evaluating the Navy's treatment of the above cost factors, potential questions include the following:

- How reasonable is it for the Navy to estimate that the second source under the dual-award strategy would have a steeper shipyard learning curve, lower shipyard labor rates, and a lower profit rate than the second source under the down select strategy would have had? Given the number and capabilities of

⁸⁰ The Navy also adjusted its cost estimate to account for differences in production quantities of scale for LCS combat systems that would occur under the down select and dual-award strategies. Under the down select strategy, one combat system maker would make combat systems for all LCSs. Under the dual-award strategy, two combat system makers would each make combat systems for one-half of the LCSs.

shipyards that might have participated in the second stage competition under the down select strategy, the potential intensity of a competition among these yards to win a share of a large Navy shipbuilding program, and the uncertainty about which specific yard might have won that competition, how certain can the Navy be that the second source that was chosen under that competition would have a shallower learning curve (and that it would not make facility investments to achieve a steeper curve), higher labor costs, and a lower profit rate than the second source under the dual-award strategy?

- How reasonable is it for the Navy to estimate that the second source under the down select strategy would have higher vendor material costs, given that this second source might have been a builder of other Navy ships and consequently might have been able to bundle its LCS material purchases together with those for its other Navy ships, so as to achieve increased economies of scale in material production? Navy officials in recent years have encouraged shipyards to achieve cross-yard economies of scale of this kind.
- If the second source under the down select strategy were instead estimated to be equal to the second source under the dual-award strategy in terms of shipyard learning curve slope, shipyard labor rates, vendor material costs, and profit rates, how much would this reduce the Navy's estimate of the savings in ship procurement costs that would occur under the dual-award strategy?

CBO Estimate

In contrast to the Navy, which estimated that ship procurement costs would be lower under the dual-award strategy, CBO in its December 10, 2010, letter report estimated that ship procurement costs would be \$740 million higher more through FY2015 under the dual-award strategy. CBO's letter report included several cautionary statements about its estimates relating to limits on the information available to CBO in developing its estimates. The Navy and CBO estimates of ship procurement costs through FY2015 are summarized in **Table F-1**.

Table F-1. Navy and CBO Estimates of Ship Procurement Costs Through FY2015 Under Down Select and Dual-Award Strategies

For the period FY2010-FY2015, in current (i.e., then-year) dollars

Acquisition approaches	Estimated Cost
Navy estimate	
19-ship down-select plan	10,400 million
20-ship dual-award plan	9,800 million
Difference between two plans	Dual-award plan costs \$600 million <i>less</i>
CBO estimate	
19-ship down-select plan	11,080 million
20-ship dual-award plan	11,820 million
Difference between two plans	Dual-award plan costs \$740 million <i>more</i>

Source: Table prepared by CRS based on data presented in Congressional Budget Office, letter report to Senator John McCain on LCS acquisition strategies dated December 10, 2010, Table 2 on page 5.

December 14, 2010, Hearing

At the December 14, 2010, hearing on LCS acquisition strategy before the Senate Armed Services Committee, the Navy witnesses defended the Navy's estimate, stating that it was based on actual bid data from the two LCS bidders, and that CBO's estimate did not reflect full exposure to this bid data, because the data was proprietary and was being closely held by the Navy pending a potential announcement by the Navy of a down select decision (if the dual-award strategy were not pursued).

As discussed in the previous section, however, the Navy's estimate was also based on certain assumptions about the unknown shipyard that would have been chosen under the second-stage competition that would have occurred under the down select strategy. The Navy's assumptions about this unknown yard compared to the second source under the dual-award strategy accounts for some portion of the Navy's estimated savings.

Potential Changes in Costs of Other Ships Not Accounted For

Under the down select strategy, shipyards competing to become the second LCS builder could include yards that currently build other ships for the Navy, such as, possibly, General Dynamics' Bath Iron Works (GD/BIW) of Bath, ME, Northrop Grumman's Ingalls shipyard of Pascagoula, MS, or General Dynamics' National Steel and Shipbuilding Company (NASSCO) of San Diego, CA. If such a yard were to be selected under the down select strategy to become the second LCS builder, it could reduce the cost of other Navy ships being built at that yard by more fully spreading the fixed overhead costs of that yard. The Navy and CBO estimates in **Table F-1** do not account for possible changes in the costs of other Navy ships that might be occur as a consequence of changes in the spreading of shipyard fixed overhead costs.

Combat System Modification Costs

Any savings the dual-award strategy might realize relative to the down select strategy in terms of costs for procuring LCSs could be offset by potential additional costs under the dual-award strategy for modifying the combat systems on LCSs so as to achieve more commonality in combat system equipment among all LCSs, and between LCSs and other Navy ships. Prior to its September 2009 announcement of its proposed down select strategy, Navy officials on some occasions had spoken about the possibility of modifying the combat systems of one or both LCS designs so as to achieve more commonality in combat system equipment among all LCSs, and between LCSs and other Navy ships.⁸¹

A November 29, 2010, press report stated that "the Navy intends to keep separate the combat systems of the Lockheed and Austal USA versions of the Littoral Combat Ships for its dual buy strategy, but will 'procure the tech data package to allow for consideration of [a] common combat system in the future,' according to Navy spokeswoman Capt. Cate Mueller." The report also quoted an industry official as saying that the Navy is likely "still strategizing as to how they're going to single up on a combat system."⁸²

⁸¹ See, for example, Christopher P. Cavas, "Two LCS Designs, One Big Dilemma," *Defense News*, December 13, 2010: 22.

⁸² Andrew Burt, "Navy Open To Combining Combat Systems On Both Littoral Combat Ships," *Inside the Navy*, (continued...)

At the December 14 hearing, the Navy stated the following regarding the issue of potential combat system modification costs:

The current [LCS] acquisition strategy does not call for the changeout of the [LCS] combat system.

Let me describe some characteristics of the combat system. As it was mentioned earlier, the total cost for the [LCS] combat system is on the order of about \$70 million. When we think of the combat system, we break it down into a couple key components – weapons, sensors, and command and control [aka command and decision, or C and D] system. We have in fact, on the weapons side of the combat system, commonality [between the two LCS designs]. Both ships' 57-millimeter Bofors guns, both ships we're looking at RAM–CRAM [sic: RAM or SEARAM] weapons systems. So the weapon system is already common both between them and also with other ships in the inventory.

Now, on the sensor side, we have contemplated moving towards a common sensor, and inside of this solicitation the Navy asked for priced bids for a new sensor to consider for the future. In total, the cost for bringing a new sensor—that's both common for LCS and with the rest of the fleet—is about \$20 million nonrecurring and about \$2 million a ship difference.

So weapons are common. If the Navy chose to go to a common system for performance reasons, the cost impact would be about \$20 million nonrecurring and a couple million dollars a ship.

Then on the C and D side, which is largely the software system and displays and processors, the Navy does not have a drive right now to go towards common C and D for this class either in the down-select or dual-award. It is something that we could consider in the future.⁸³

A January 17, 2011, press report stated:

"The median class size in the Navy is about 12 to 14 ships, so we have a lot of 12-ship classes that have their own combat system," [Rear Admiral David Lewis, the Navy's program executive officer for ships,] said, "so we have no plans on changing the combat system on the ships. They're effective. At this point, they meet the requirements, and so I don't see any appetite in the Navy for changing those."...

Lewis admitted that the business case could change after the two 10-ship contracts have run their course, but said he was skeptical it would make more sense to change combat systems then than now.⁸⁴

(...continued)

November 29, 2010. Material in brackets as in original. The Austal USA version of the LCS is the version developed by the General Dynamics-led LCS industry team.

⁸³ Transcript of spoken testimony of Sean J. Stackley, Assistant Secretary of Navy for Research, Development, and Acquisition.

⁸⁴ Cid Standifer, "Rear Adm. Lewis: Navy Has 'No Appetite' To Change LCS Combat System," *Inside the Navy*, January 17, 2011.

Life-Cycle Operation and Support (O&S) Costs

Any savings the dual-award strategy might realize relative to the down select strategy in terms of costs for procuring LCSs could also be offset by potential additional life-cycle operation and support (O&S) costs of operating significant numbers of two different LCS designs. A December 8, 2010, GAO report states: “According to the Navy, [estimated savings in LCS procurement costs under the dual-award strategy] would be offset, in part, by an additional \$842 million in total ownership costs, which the Navy equates to a net present value of \$295 million.”⁸⁵ The Navy confirmed this figure at the December 14 hearing, and stated that this estimate was carefully prepared and consistent with past Navy analyses on this question.

GAO’s December 8 report states:

Navy officials expressed confidence that their cost estimate supporting the dual award provides details on the costs to operate and support both designs. However, since little actual LCS operating and support data are available to date, the Navy’s estimates for these costs are currently based on data from other ships and could change as actual cost data become more available. These estimates are also based on new operational concepts for personnel, training, and maintenance that have not been fully developed, tested, and implemented. For example, the Navy has not yet implemented a comprehensive training plan, and it is possible that the plan could cost more or less than the training costs currently accounted for by the Navy.⁸⁶

CBO’s December 10 letter report states:

Operating and maintaining two types of ships would probably be more expensive, however. The Navy has stated that the differences in costs are small (and more than offset by procurement savings), but there is considerable uncertainty about how to estimate those differences because the Navy does not yet have much experience in operating such ships.⁸⁷

Resulting Net Costs

Using the above information, it appears that the Navy estimates that, compared to the down select strategy, the dual award strategy might save a net total of \$615 million (net present value) through FY2016, or \$201 million (net present value) through FY2015. This figure includes \$910 million (net present value) in savings in ship procurement costs through FY2016, or \$496 million (net present value) in ship procurement costs through FY2015, less \$295 million (net present value) in additional ship O&S costs.

This figure does not account for possible changes in the costs of other Navy ships that might be occur as a consequence of changes in the spreading of shipyard fixed overhead costs. The estimated net savings of \$615 million (net present value) through FY2016 (\$201 million [net present value] through FY2015) would be reduced by any LCS combat system modification costs. Navy testimony at the December 14 hearing suggests that combat system modification

⁸⁵ Government Accountability Office, *Navy’s Proposed Dual Award Acquisition Strategy for the Littoral Combat Ship Program*, GAO-11-249R, December 8, 2010, Table 1 on page 3.

⁸⁶ Government Accountability Office, *Navy’s Proposed Dual Award Acquisition Strategy for the Littoral Combat Ship Program*, GAO-11-249R, December 8, 2010, p. 6.

⁸⁷ Congressional Budget Office, letter report to Senator John McCain on LCS acquisition strategies dated December 10, 2010, p. 3.

costs might range from zero (no modifications) to a few tens of millions of dollars (changing the radar on the ships).

Using CBO's estimate rather than the Navy's estimate for relative ship procurement costs (see **Table F-1**) would make the dual-award strategy more expensive than the down select strategy. As mentioned earlier, the Navy witnesses at the December 14 hearing defended the Navy's estimate of ship procurement costs, stating that it was based on actual bid data from the two LCS bidders, and that CBO's estimate did not reflect full exposure to this bid data, because the data is proprietary and being closely held by the Navy pending a potential announcement by the Navy of a down select decision (if the dual-award strategy is not pursued).

Relative Risks

Regarding the potential relative risks of the down select and dual-award acquisition strategies, the December 8 GAO report states that "a second ship design and source provided under the dual award strategy could provide the Navy an additional hedge against risk, should one design prove problematic."⁸⁸ It might also be argued that the dual-award strategy avoids the construction risks present under the down select strategy of having LCSs built by a shipyard that has not previously built LCSs.

On the other hand, it might be argued that if there *is* a substantial risk of an LCS design proving problematic, then the LCS program should not be put into series production in the first place, and that if there *is not* a substantial risk of an LCS design proving problematic, then the value of hedging against that risk would be negligible. It might also be argued that managing the construction of two very different LCS designs could place increased demands on overall Navy program management capacities and on the Navy's Supervisor of Shipbuilding (SUPSHIP) capabilities for on-site monitoring of the construction of Navy ships—factors that might increase the chances of program-management challenges in the LCS program or of the Navy not detecting in a timely manner construction-quality problems that might occur in one or both LCS designs.⁸⁹

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⁸⁸ Government Accountability Office, *Navy's Proposed Dual Award Acquisition Strategy for the Littoral Combat Ship Program*, GAO-11-249R, December 8, 2010, p. 4.

⁸⁹ Limits on Navy SUPSHIP capacities may have been a factor in the delayed discovery by the Navy of construction quality problems on Navy San Antonio (LPD-17) class amphibious ships. For a discussion of LPD-17 class construction quality problems, CRS Report RL34476, *Navy LPD-17 Amphibious Ship Procurement: Background, Issues, and Options for Congress*, by Ronald O'Rourke.